The Dock and Harbour Authority

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CONTENTS

Editorial Comments

The Port of Lancaster

Among the lesser known ports of this country. Lancaster, an article on which appears in the present issue, takes a dignified place. With its ancient traditions and historic associations it fittingly deserves the epithet of "time-honoured," which Shakespeare in his play of Richard II makes that king apply to the then holder of the ducal title. Readers familiar with the great poet's works will have little difficulty in recalling the oft-quoted opening line:

"Old John of Gaunt, time-honoured Lancaster."

It is to be observed, in passing, that critics have pointed out that Shakespeare was in error in speaking of Edward III's fourth son as a very old man at the time of the play, for he was but fifty-eight years of age. However that may be, the epithet has clung and has given the impression of a venerable and prudent statesman which seemingly little befitted his real character. The town, from which he took his title, is undoubtedly venerable, having an origin ancient as the time of the Romans, such evidence of which as is extant being incorporated in Mr. Shaw's article.

Venerability seems, indeed, to be a suitable keynote also for the dscription of the port and its administration. The record of active service of the present Acting Clerk to the Port Commissioners is surely unsurpassed and unchallengeable. We cannot think that there is another acting port official in this country coeval with Mr. Shaw. It is given to few men to maintain their intellectual force and bodily vigour to the advanced age of ninety. His hand-writing, we may add, is firm and clear: it would do credit to a man of half his age.

Of the activities of the port, much restricted since the outbreak of the present war, we must leave Mr. Shaw to speak. There is still every prospect of a trade recovery for this ancient seat of commerce and in the yet unfolded annals of the future, it may attain a position of importance, commensurate with the significance of its setting on the coast line of one of the most prominent manufacturing counties in Great Britain.

Jetty Design.

In this issue, through the courtesy of The Institution of Structural Engineers, we are permitted to reproduce an article by Mr. R. R. Minikin, on The Design of Jetties, a subject which cannot fail to be of interest to harbour engineers.

There are jetties of various kinds: some of solid construction and others of open framework. Mr. Minikin confines his survey of jetty design to those of piled construction. In regard to jetties of this type, there are a number of special and important points for consideration, and not the least is the question of impact of vessels, either arriving to be berthed, or possibly even colliding by accident, due to faulty manœuvring alongside. The nature and extent of these concussions are carefully analysed in the article.

Having had, on more than one occasion, to investigate this problem ourselves, we have been struck by the insufficiency of the data available and the precarious nature of many of the assumptions which have to be made. In order to arrive at the kinetic energy of the blow, it is necessary to determine the vessel's momentum and for this, a certain velocity has to be assumed within limits of probability. But these limits are fairly wide, and in two cases of jetty construction described within recent years in papers to the Institution of Civil Engineers, the author in one case adopted for his calculation a speed of approach by the vessel which was just double that of the other. Since the force of the blow varies as the square of the velocity, the result arrived at in the first case was four times as great as that in the second. Then the distribution of impact on the face of a jetty is another indeterminate problem on which a wide range of assumptions is possible.

Mr. Minikin, makes one rather remarkable statement, based on experiments he has carried out on model apparatus. On the average of a number of tests with wood on wood collision, he found that only 0.18 to 0.27 of the kinetic energy of the vessel is imparted to the jetty in head-on impact. This leads us to the observation that, in the matter of impact, jetties of reinforced concrete construction are at a disadvantage in comparison with timber jetties. The natural resilience of timber enables it to resist without detriment a blow which would be definitely harmful to concrete piling; even if the piling were not actually fractured, it might be cracked to a degree which would admit external moisture to the steel reinforcement and so produce corrosion. We have seen a pier on long timber piles in New York Harbour rebound a matter of several inches to impact from a vessel of the transatlantic type without suffering any apparent injury. This unscathed recovery could hardly have resulted, if the piling had been of reinforced concrete. Fendering, no doubt, mitigates the evil, but cannot remove altogether the possibility of damage.

Editorial Comments—continued

The importance of a closer determination of the intensity of impact on jetty structures would justify the compilation of a series of dynamometric readings, though obviously there would be difficulties in arranging for them effectively.

River Boards.

The recently issued third report of the Central Advisory Water Committee contains various topics of interest and importance to Port Authorities. It deals with the subject of River Boards and the proposal which has been put forward to constitute new authorities to take over some or all of the functions of the existing bodies responsible for river control.

In preparation of this report, the Committee have had to handle a very difficult and complicated problem. The characteristics of rivers are of a most diverse kind, and their effective management has to be correspondingly varied in character. The primary and fundamental function of rivers is, of course, the discharge into the sea of rainfall, not absorbed in the ground or evaporated into the air. But there are other, and equally important, duties for river conservators besides land drainage, such as those relating to water supply, flood control, public health (sewage disposal, with concurrent prevention of pollution), irrigation, fisheries, commerce, power for industry, transport and navigation, and also as regards amenities for inhabited districts and recreation for the population. With many (even most) of these, this Journal is not particularly concerned, but our readers are intimately interested in questions of navigation and transport. Port operation and shipping movements are essentially linked up with the maintenance of channels and estuaries. At the same time, it is not merely in regard to the effective navigability of rivers that port authorities are involved. Dock and Harbour Authorities have general powers under the Merchant Shipping Act, 1894, to supervise the discharge of polluted effluents into tidal waters, and certain conservancy authorities, with interests in navigation, are also responsible for fisheries and land drainage.

The sections of the report relating specifically to Navigation and Canals and Ports are extracted and reproduced in this issue. It will be seen that a cautious attitude is adopted by the Committee in regard to the transfer to the proposed new Boards of functions exercised by inland river Navigation or Dock and Harbour Authorities. This is only to be done by an Order from the Ministries of Health and Agriculture and Fisheries, after consultation with the Ministry of War Transport or any other department involved. It is admitted that serious difficulties might arise from the transfer, and we are of opinion that this would undoubtedly be the case. The adaptation and training of river channels to meet the requirements of commercial and shipping interests is not a matter on all fours with other fluvial problems, and has features for which special technical knowledge is essential. On the whole, it is preferable that such matters should be dealt with by an *ad hoc* body in an entirely independent manner. It would be unfortunate for an issue of importance to shipping interests to be decided on the possibly preponderating vote of a Board membership chiefly associated with drainage, sewerage or irrigation. It is quite conceivable, indeed, that on certain points the interests of the various sections represented might be distinctly antagonistic and irreconcilable. An over-ruling decision should, in that case, not depend on mere magnitude of voting power in a mixed assembly, nor is it desirable that it should be contingent on the complaisant acquiescence of non-interested parties.

The evidence given by Mr. Kissane on behalf of the Dock and Harbour Authorities' Association indicated a general opposition on the part of that body to the proposed transfer of powers on the ground that it would be an encroachment by a new body in an area in which harbour authorities already have wide jurisdiction. He emphasised the commercial nature of canals and navigations and "strongly suggested" that, in any future legislation it should be made compulsory on an authority invested with navigation powers to charge tolls to cover the cost of navigation.

The attitude of the Canal Association towards the proposals is indicated in the representations which they made to the Ministry of Health in February, 1938, objecting to any general transference of powers and functions relating to navigation to new River Boards on the grounds that difficulties would arise from the combination of the trading and business functions of canal undertakers with the purely administrative functions of other Authorities, and that it would be impracticable to separate transport and trading activities from the navigational functions exercised by the undertakers. There are, in fact, a number of complicated knots to be unravelled, if there is to be any disturbance of the existing regimen.

As the report will receive further consideration both by the Dock and Harbour Authorities' Association and the Canal Association, we will not pursue the matter further at this stage, beyond remarking that it seems somewhat inappropriate that proposals fundamentally affecting shipping and commercial interests should be dealt with under the aegis of the Ministry of Health. It is true that the question of pollution prevention also arises, and that in this respect port authorities exercise powers which lie within the demain of public health; but so far no trouble has been experienced in the discharge of responsibilities under this head in tidal waters where ports are mainly located, and the Association of Dock and Harbour Authorities may well feel the position should be left as it is.

Pernicious Strikes.

The past month or six weeks has been notable for a spate of strikes—at the dockside, in the shipyards, in the coal fields and among engineering and electrical workers—all extremely regrettable at a time when every ounce of energy is required for the prosecution of the war. On September 21st it was reported in the Press that nearly 20,000 workers in Great Britain were on strike. The statement is staggering in its implications.

Dockside strikes have occurred at London, Cardiff and Liverpool; fortunately, the stoppages have been of short duration and, in the two earlier cases, have been satisfactorily and promptly settled, the causes being so trivial that the strikes ought never to have taken place at all.

At Liverpool, where thirty-four dock workers employed under the Ministry of War Transport Dock Labour Scheme were suspended for seven days for refusing to work after 7 p.m. on August 10th, the strike, though only lasting actually four days, resulted in a lengthy dispute and in the appointment by the North-West Regional Port Director (Mr. R. Letch) at the beginning of September of a Committee of Investigation with Mr. F. A. Sellers, K.C., as Chairman and Messrs. Thomas W. Condon, O.B.E., and G. Grinling Harris as members. Mr. Condon, who is the nominee of the Transport and General Workers Union, has worked for both the Port of London Authority and its predecessor, the London and India Docks Company. Mr. Harris is a solicitor London and India Docks Company. Mr. Harris is Secretary of the Thomas District Committee of the Shipping Federation.

Up to the time of writing, no result of the enquiry has been promulgated and, possibly, the official findings may not be published. From the point of view of the national interest, the regrettable feature in the majority of strikes is that, despite the provision made for official enquiry into any alleged grievances of dock labour, and the assurance of redress in case of injustice, the men will persist in taking matters into their own hands, instead of following the legal and proper course open to them. Such obtuseness is inexcusable; it, unfortunately, indicates the backward mentality of a large section of the labouring classes, who are ready to resort to extreme measures on the least provocation.

The Dock and Harbour Authorities' Association.

We have been informed that the above Association, which has hitherto limited its Membership to Public Dock, Harbour and Pilotage Undertakings, Municipal Ports and the Manchester Ship Canal Company, of which it has some 63 members in the United Kingdom and Northern Ireland, has invited the four Amalgamated Railway Companies to join in respect of their numerous docks and harbours. This invitation was accepted, and a Special General Meeting of the Association was held in London on September 29th, which formally approved the alterations to the Constitution and Rules which this proposal rendered necessary. Such an increase in membership will naturally add to the prestige and usefulness of the Association, and is very timely in view of the important post-war problems which will have to be considered.

The Port of Lancaster

An Account of its History and Development

Compiled from notes furnished by JAMES B. SHAW, Commissioner and Acting Clerk to the Port Commission

Ancient History

THE origin of the Port of Lancaster is lost in the mists of antiquity. Fragmentary records of old time show that Longovicum or Lune Castrum was an important Roman station and the principal port of the era during the Roman occupation of Britain. Certainly, on the North-west Coast, it was the nearest point of supply to Hadrian's Wall, at the point, where the road constructed by Hadrian approached the sea before turning inland and ascending the hills of the Cumbrian Range, through which it passed over steep and almost inaccessible heights to the Vallum, the frontier of the empire in Britain. The Vallum, it may be explained, was an earth embankment lying to the South of the main Murus, or stone wall. According to some authorities, the Vallum was the work of Hadrian and the Murus of Severns. Other authorities maintain that the whole fortification should be credited to Hadrian. Except to antiquarians the point is of no essential importance.

Mr. James Bibby Shaw (Acting Clerk)

Mr. Thomas Edmund Birkbeck (Chairman)

Some writers are of opinion that Lancaster was the Portus Sistuntiorum mentioned by Ptolemy. The present name of Lancaster is derived from the River Lon, anciently so denominated and more modernly, the Loyne or Lune (the river makes a bend like a crescent moon), and Castra, a camp or fortress: "Luna et Castrum," thus Camden, "which the inhabitants call Loncaster and the Scots Loncastell." The motto of the town is "Luck to Loyne."

The poet Spenser makes a reference to its name as follows: "after came the stony, shallow Lone, that to old Lancaster its name doth lend."

Lancaster lies at the head of the estuary of the River Lune, about 7 miles from the sea. After the Romans, the Danes inhabited it, and in the seventh century, A.D., it had risen to such importance as to be made the capital of the county. At the Norman Conquest, the place became the possession of Roger de Poictou, who founded a castle there. It was round the castle that the town grew up and, in 1193, John, Earl of Mertown, who afterwards became king, granted it a Charter, and another in 1199, after his succession. Under the former Charter the burgesses enjoyed similar privileges to those at Bristol, and under the second, all the liberties which the burgesses of Northampton had on the day when King Henry died, instead of those of Bristol. This second Charter was confirmed by several subsequent sovereigns.

For some centuries the town had a chequered career, being three times burnt down by the Scots, viz., in 1314, 1322 and 1389 and on another occasion, in 1643, captured by the Parliamentarians during the Civil War.

In the reign of Charles II, Lancashire was required to furnish a vessel of war for the Navy, and towards this object Lancaster contributed the sum of £30, while Liverpool and Preston each paid only £25.

In the early part of the Eighteenth Century Lancaster was included as part of the Port of Chester.

Walney Lighthouse and Two Cottages, looking seawards, with ruins of Piel Castle in the distance on the left.

Later Development.

The Port has suffered in the past much inconvenience from difficulty in the navigation of the River Lune, arising from the accumulation of sand in its channel and an elevation in its bed, called Scaleford, probably the remains of a Roman ford across the river, which rendered it unsuitable for vessels of large burthen.

Up to the year 1749, vessels had to lie in the river bed and along the banks of the river, in order to discharge their cargoes into

The old St. George's Quay, now made into an Esplanade.

carts. The difficulty of such measures compelled merchants and traders to seek another method of dealing with the trade of the port. At a meeting of the inhabitants it was resolved to petition Parliament for an Act to empower certain individuals to act as Trustees and Commissioners. Power was granted, an Act was passed and Commissioners were elected by the shipowners. These framed rules and bye-laws for regulating the port and for the improvement of navigation in the river. Powers were granted for the

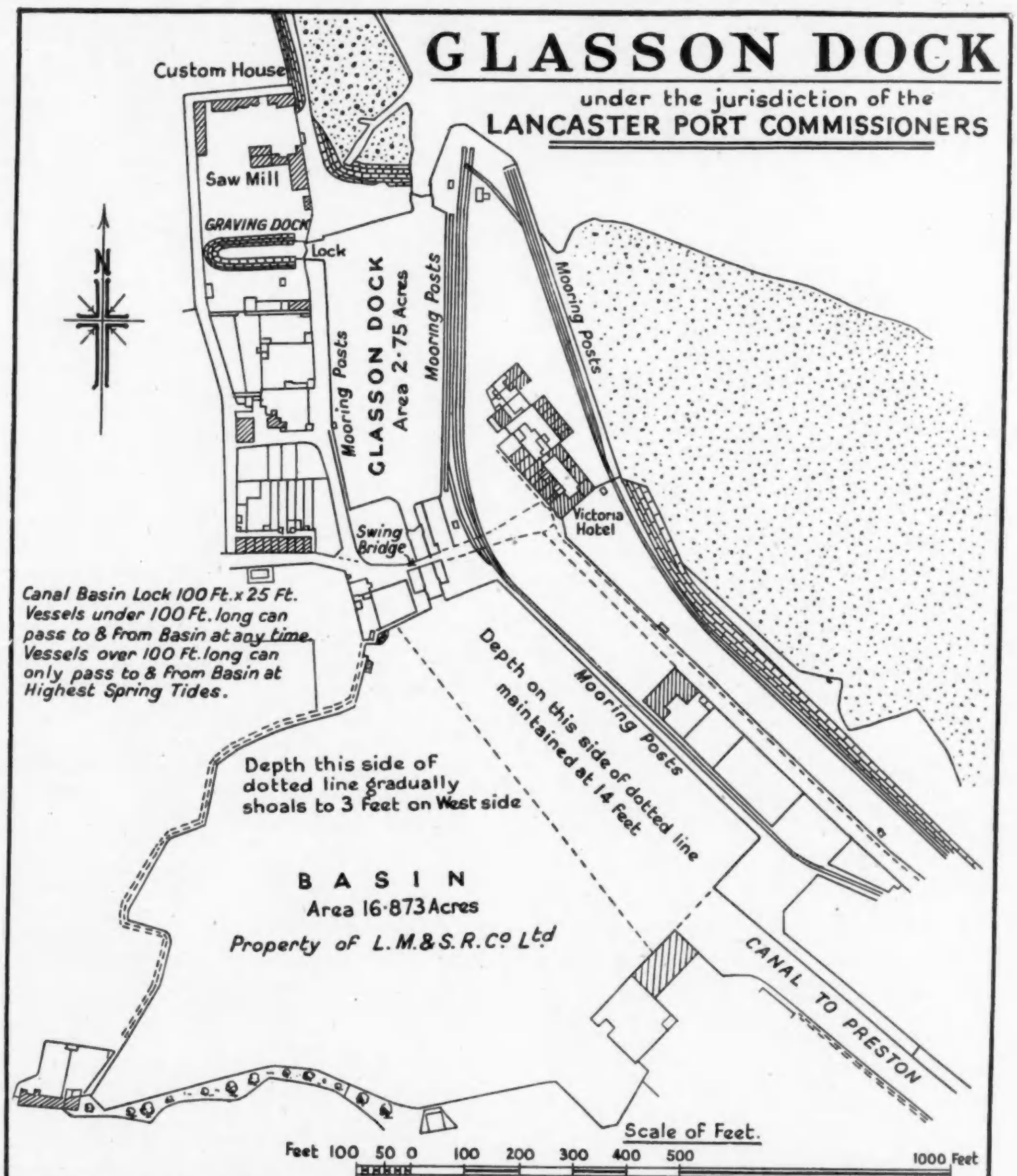
Port of Lancaster—continued

construction of quays and wharves, and also to buoy, perch and light the river channel and to remove all obstacles therefrom between high water to high water on each side of the river.

Work was put in hand at once, and in 1750 the St. George's Quay was commenced, followed in 1767 by a new quay on Lancaster Marsh.

Provision of Custom House Buildings

In 1764 a Custom House was erected on the St. George's Quay at the request of H.M. Customs, London, replacing an older one. It cost £890 and was built from a design by Mr. Gillow, of Lancaster, with a portico and plain pediment, supported by four Ionic columns, each a single stone 15-ft. 2-in. high.



Construction of Glasson Dock

By 1783 further accommodation for shipping was found to be necessary and a dock was constructed in that year, nearly 5 miles down the river, for the purpose of accommodating vessels which had discharged their cargoes into lighters for delivery on St. George's Quay. The Glasson Dock is 500-ft. long and 200-ft. wide and has an entrance 35-ft. in width. The lock connecting this with the Lancaster Canal is 100-ft. long and 25-ft. wide. The quayage in the dock aggregates 700-ft. and outside, there is a length of 400-ft. of quay wall. Adjoining the wet dock is also a graving dock which was built in 1837. It is 197-ft. long (187-ft. on blocks) with an entrance width of 35-ft. A timber jetty and new pier were constructed during the same century, with sidings and quayside appliances.

When the Port of Barrow-in-Furness came into prominence, the Customs Officials left Lancaster for Barrow. The building afterwards became the Office of the Commissioners until May, 1942, when they removed to their present premises.

Additional Quayage

In 1765, a stone quay was constructed on the marsh by reason of the fact that there was a greater depth of water available there than at St. George's Quay. An additional quay was constructed in 1888. It is now called the New Quay. It has a length of 470-ft. and a depth limited to 6-ft. at neap tides and 12-ft. at spring tides.

Somewhere about the year 1700 a jetty was constructed at Sunderland, about 6 miles below Lancaster, on the west side of the

Port of Lancaster—continued

river. Vessels of greater burthen could moor there and discharge into lighters for the St. George's Quay.

Channel Demarcation

In 1766, a land mark was erected at Rossall Point, near Fleetwood, as a guide to vessels entering the River Lune. It was renewed in 1847. About 1923, the shipmasters petitioned the Commissioners to have it removed, claiming that it was of no further use and the cost of repair was proving excessive. Trinity House was approached on the matter and agreed to the proposal, so it was demolished in 1924.

Walney Lighthouse

In 1790, Walney Lighthouse was erected on land at the South end of Walney Island. The lease of the site was for 10,000 years at an annual rent of one peppercorn. It had a revolving light constructed on a model made by Captain Richard Walker, a Commissioner of the Port, using reflectors and oil lamps. It is believed to be the first revolving light to be installed in a British Lighthouse.

In 1846 a pillar light was erected on Hawes Point near the above lighthouse to direct vessels along the channel to and from the Port of Barrow. This was also oil lighted and showed a red light. The two lights were subsequently illuminated by acetylene gas, Walney Light in 1909 and the Hawes Point Light in 1912. In 1937, the light at Walney was increased from one flash per minute

The old Custom House. On the left, a corner of an old 18th Century Warehouse. On the right, other 18th Century Warehouses (a little shop wedged in between).

to one flash every 15 seconds. The candle-power of the light was increased about 12,000.

Railway Communication

Railway communication was established with the Town and Port in June, 1840, when the Preston and Lancaster railway was opened, followed six years later by the completion of the Lancaster and Carlisle Railway.

Present Position

At the present time, the berths at Lancaster are a considerable source of anxiety and expense to the Commissioners owing to the accumulation of sand, which has to be constantly removed. In

Cockersand Abbey Lighthouse, timber-built on land.

the rainy season, freshets are another source of trouble by sometimes depositing detritus, or material such as logs of trees, stones, etc., which have to be cleared away and necessitate constant attention.

The Port is suitable for coasting vessels accustomed to take the ground alongside the quays at low water. Such vessels should not be more than 130-ft. long, the limit of draught being 6-ft. at neap tides and 12-ft. at spring tides.

The Port Commission.

The Commissioners and Trustees of the Port are a body of about 17 members. The personal photographs accompanying this article are those of the Chairman and the Acting Clerk of the Commissioners.

Mr. Thomas Edmund Birkbeck, the Chairman, is a Fellow of the Auctioneers' and Estate Agents' Institute and a Fellow of the Faculty of Surveyors of England. He is a member of the Council of the Lancaster Chamber of Commerce. He is also an ardent yachtsman and has sailed round the Scottish Coast in his yacht, at present laid up in Glasson Dock.

Mr. James Bibby Shaw, in addition to being Acting Clerk, is also a Commissioner. He has attained the remarkable age of 90 while still discharging his official duties. As far back as 1873-5, he served in the 24th Lancashire Artillery Volunteers and in 1877 in the Melton Mowbray Company of the Leicestershire Rifle Volunteers. He is a prominent Freemason in the County, being Chairman of the Lancaster and District Group of Freemasons.

The Design of Jetties*

By R. R. MINIKIN

Introduction.

MUCH ado is made nowadays about the application of scientific method in the analyses of physical problems. It therefore appears incongruous that published matter in text-books, technical periodicals, and institutional papers, does not show that the basic principles of jetty design have been so treated. This is all the more surprising as jetty design has improved considerably in the last 25 years. It may be that this is due to a more complete investigation of the stresses in individual members consequent on the wide use of reinforced concrete, nevertheless many of the preliminary assumptions are not convincing, and are related to the "old rules of thumb." It can be conceded that in dealing with hydraulic structures, long experience is worth much more than theory and if some part of that experience can be quantitatively established then a definite progressive treatment may be initiated. Of late years many researches have been carried out regarding the behaviour of materials, soils, water, etc., under stress, that a continued employment of unreasoned assumptions is indefensible, in fact the progressive nature of scientific knowledge makes it incumbent upon engineers to throw away old fashioned note-books of "thumb" data and to design structures to meet the ever-changing conditions of the present-day requirements, basing them on the latest public knowledge. Much of the science of engineering design is economic, and to that end, structures should be adequate for their function and not monuments for posterity. Because a jetty built some decades ago still remains in use is not necessarily a credit to the professional skill of the builder, and still less is it an adequate reason why its design and proportions should be duplicated or copied to-day. There may be points about it of interest and engineering skill but surely most of the good points of our predecessors have already been assimilated into current practice.

The main essential in all design is to obtain relevant facts and to appreciate their significance. They should be classified, and their relationship assessed so that where they overlap, diverge, or coincide in effect, the respective values may be reasonably apportioned. We are not compelled in applied mathematics any more than in pure mathematics to abide by rigid or absolute rules regarding assumptions, providing, by their use, a fair and reasonable interpretation of phenomena may be quantitatively evaluated; such assumptions need not be symbolic of the phenomenon but the process of reasoning should be as nearly related to observed facts as is practically possible. Much of an engineer's time is spent in conforming to certain principles of design which have been automatically accepted in good faith; in other words, as legacies from something which has been used before with certain public authority. Many of them have proved to be convenient servants insomuch that few troubles have been traced to their use, and the best that can be said about them is that they are merely "old experience." Few of us, on reflection, could contribute any valid reason for their continued use for current conditions; after all, the background of experience is confidence in the present and not reliance on the past.

It is therefore proposed in this paper to indicate in simple terms what may be a more useful and economic approach to jetty design, confining our attention to a piled construction.

Bearing Capacity of Piles.

To experienced piling engineers it is well known that as a driven pile passes through soft stratum towards and into one that is harder or more compact the toe pressure increases in proportion to the higher shear resistance of the newly-entered material. On the other hand in passing through a firm stratum and approaching a softer layer the driving resistance is diminished. Now it may be observed that the total resistance to driving is governed by the amount of resistance at the toe rather than by the friction on the surface of the pile, providing the pile is kept in motion. Thus if a pile pierces several layers of varying characteristics the layer in which the toe rests has the greatest influence on the bearing capacity. (See Fig. 1.) In wet clays it is frequently observed that there is no increase of resistance after considerable penetration. This is due to two causes; the expulsion of the pore water forms a film on the pile surface and prevents the mobilization of full frictional resistance; the temporary moulding of the ground hollow surrounding the pile which is kept intact by the hydraulic pressure occasioned by driving. After some period of rest this type of clay frequently closes back on the pile so that a recommencement of driving would show an added resistance to penetration. From a considerable number of observations the author finds that the following figures of equivalent skin resistance shew a fair average for computing the probable embedded lengths of piles in different strata.

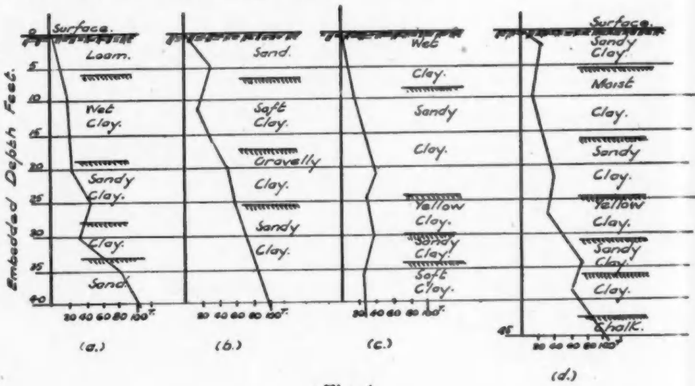


Fig. 1.

Wet clay	$n = 0 \cdot 25$	tons per square foot of pile surface.		
Sandy clay	$0 \cdot 5$	,,	,,	,,
Gravelly clay	$0 \cdot 58$	,,	,,	,,
Ordinary clay	$0 \cdot 43$	,,	,,	,,
Hard clay	$0 \cdot 53$	,,	,,	,,
Sand	$0 \cdot 65$	,,	,,	,,
Chalk	$0 \cdot 60$	,,	,,	,,

It should be noted that these values are only applicable where the soil layers are not less than 4 pile diameters thick.

Then $R = 2\ W = npl$ ....(1.)
where R = ultimate resistance to penetration, tons.
W = Safe load on pile, tons.
n = co-efficient in above table.
p = perimeter of the pile, feet.
l = embedded length of the pile, feet.

For example, a 14" square R.C. pile is to be driven through several thin layers of soil into a deep bed of sandy clay. The load on the pile is 40 tons.

$$R = 2 \times 40 = 0 \cdot 5 \times 4 \cdot 66 \times l$$
$$l = 35 \text{ feet approx.}$$

From which we assume that the probable embedded length of the pile is 35 feet and if the deck level of the jetty is, say, 25 ft. above the bed, the probable length of piles required will be 60 feet. Assuming this to be suitable an approximation to preliminary driving instructions can be sought as:—

Set per blow for loading.

Hiley formula. $R = 2\ W = n \dfrac{W_1 h}{S + c/_2} + (P + W_1)$ ....(2.)

* Reproduced by permission from *The Structural Engineer*, Journal of the Institution of Structural Engineers.

The Design of Jetties—*continued*

where W_1 = weight of hammer in tons.
P = weight of pile and helmet, tons.
h = free fall of hammer, inches. Adjusted to machine.
s = set per blow, inches.
c = temporary compression from tables.
n = efficiency of blow co-efficient.

Values found from Mr. Hiley's tables for the case considered are $c = 0{\cdot}71$ and $n = 0{\cdot}37$ which inserted in (2) give the probable set per blow $s = 0{\cdot}27''$.

Now this admirable formula which has proved of immense value to engineers does not take into account the nature of the ground or the length of the pile embedded in the ground and as will be appreciated these are most important factors affecting the actual function of jetty piles. The tables of constants given by Mr. Hiley do however take into account varying driving resistance stresses which, used by experienced engineers, give excellent results. Nevertheless the author has the opinion that a pile-driving resistance formula should in some way contain factors embodying the embedded length of the pile and carried out a wide series of (*ad hoc*) experiments. From the results of these he devised and published the following formula:

$$R = 2W = \frac{u\, W_1 h_1}{s + q\tan\phi} \quad \text{.......(3)}$$

where R = ultimate resistance of the ground to penetration.
W = safe load in same units as above.
W_1 = weight of hammer units as above.
h_1 = height of fall of hammer, inches.
s = permanent set, inches.
u = effective proportion of driving energy.
$= \left(0{\cdot}3 + \frac{W_1}{5\,P}\right)$
$q = \left(\frac{mp}{l} + \frac{L}{n}\right)$
n = 200 for soft and medium soils and clays,
100 for hard clays, compact sands and gravels.
ϕ = virtual angle of internal friction of ground.

Angle of repose	20	25	30	35	40	45
Values of m	3·2	2·8	2·5	2·0	1·7	1·5

l = embedded length of pile, feet.
L = total length of the pile plus length of dolly, feet.
p = perimeter of pile, feet.
P = weight of pile.

Inserting values as before it is found from the above formula for a pile embedded 35 feet for the given loading the required set is $s = 0{\cdot}33''$ per blow. Thus we can say that the static value of the pile is fixed, but in a jetty the function of the pile is to also withstand the shock of a suddenly imposed horizontal force and further investigation is necessary.

Impact of vessels.

There appears to be some confusion in the methods adopted to evaluate the force of impact upon jetties due to the moving collision of a ship coming alongside. Excepting from sheer accident few ships approach a jetty head on. The manœuvring usually results in first contact with the fenders of some part of the vessel considerably removed from the centre of gravity of the moving mass as shewn in Fig. 2. In a tideway or current the vessel is usually headed into the current at a suitable navigating angle and speed to bump the jetty along line A B at, say, C. This does not bring the vessel to rest nor is the whole of the sideways energy of the vessel absorbed. The point of impact being at some lever arm l distant from the centre of gravity, the blow tends to swing the vessel about the centre of buoyancy and causes it to move in towards the jetty as indicated. Thus the kinetic energy of the moving vessel is absorbed in

(*a*) Blow at C.
(*b*) Friction between the side of the vessel and the jetty fenders over the distance S.
(*c*) Skin frictional resistance on vessel's underwater surface by broadside movement towards the jetty.
(*d*) Skin frictional resistance on the vessel's underwater surface by forward movement parallel to jetty and/or pull on jetty by mooring hawsers.
(*e*) Final broadside collision with the fenders.

It will be appreciated that after the first collision at C there is usually a rebound or yawing of the vessel which tends to swing her parallel to the jetty. This is particularly evident in a strong tideway. Then from the vector diagram of velocities Fig. 2, the amount of energy absorbed in the first collision on the jetty is $c_1\frac{W}{2g}(v \sin\alpha)^2 + c_2\frac{W}{2g}(v\cos\alpha)^2$ where c_1 and c_2 have each a value less than 1. The remainder of the K.E. is expended as enumerated above. Thus in striking the jetty the vessel is not brought to rest immediately but the travel sideways at the point of contact C is neutralized. The vessel still moves ahead in the run of the jetty and the component of the energy along this direction is absorbed partially by frictional contact with the fenders over the distance S, or by the pull on the mooring rope, and the resistance due to the displacement of the water. The point is, that a proportion of the total K.E. of the vessel is transmitted to the jetty, part transversely, and part longitudinally. If after first striking the jetty no shore ropes were run out it is possible that the ship after striking would sheer off and expend all its remaining energy overcoming skin frictional resistance of the water until brought to rest. The practice is, however, to run out a mooring rope as early as possible, at the bow, and also at the stern of the vessel. The bow rope is rapidly hauled in and made just sufficiently taut to damp the way of the

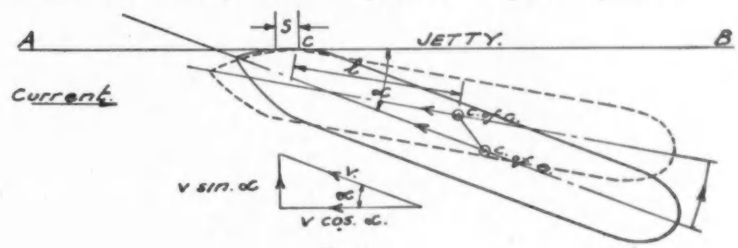


Fig. 2.

ship. If it were secured and not allowed to pay out under stress the pull would either break it or the forward energy of the ship would cause the stern to swing out away from the jetty. It will be therefore appreciated that the mooring ropes will exert a considerable pull on the jetty; the direction of this pull is such that the components are, transversely, opposite in direction and effect to the original blow and longitudinally similar in direction and effect to the original blow. The time of the blow under first impact is difficult to evaluate as it varies with the mass of the vessel, the mass of the jetty, the velocity of approach, the angle of approach, nature of contacting surfaces and tide conditions. A point of note is that in a strong current if a ship strikes a jetty with low velocity and a steep angle there is a danger of the bow swinging downstream, that is, a tendency to turn the vessel round; navigators, however, seldom make this mistake. As it is impossible to deal with individual cases a good average of adverse conditions should be considered. By good average is meant the reasonable navigating and current conditions when a vessel is likely to come alongside.

A typical section of a vessel at about fender level (i.e., about 2 feet above the load line) is shewn in Fig. 3, where the length of the vessel = L. It will be noted that for about half the length of the vessel amidships the sides of the ship are approximately parallel. If the vessel strikes a jetty at the bow end in point F then the line of the jetty AB will be a tangent to the curvature of the side at that point. Similarly at the point G the line of the jetty CD will be tangential to the curvature at that point. Now the blow at F at lever arm b from the C of G (and approximately from the centre of buoyancy) will be an isolated blow and can be logically assumed to be distributed over a length of jetty equal to twice the width, that is = 2B, if B = width of jetty; but the amount of energy absorbed in the blow will be a fraction of the total transverse approach K.E., as explained above. Coincident with this blow the after part of the vessel will swing towards the line AB and the centre of resistance of the water will then shift abaft of the C of G to some point H. From this it can be reasoned that the proportion of the forces at F and the water resistance at H opposing the motion of the vessel will be as a : a + b. Then if E = transverse com-

The Design of Jetties—continued

ponent of the kinetic energy of the ship then the amount absorbed by the blow at F is

$$\frac{a}{a+b}E$$

and this value will be a maximum at the point where the curvature enters the straight side of the vessel. Should the blow be delivered near this point as at G, whilst it may be momentarily an isolated blow, before it has time to develop its full force, the ship, being almost parallel at the moment of contact with the jetty, will swing broadside on and the actual blow will then be delivered over a length of jetty $= L/2 + 2B$ exhausting the whole of the sideways energy.

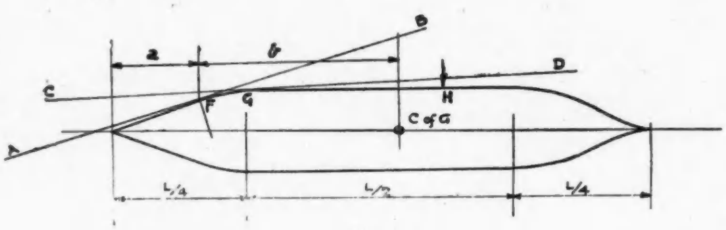


Fig. 3.

If this argument is true, or approximately true, then the maximum isolated blow that can be delivered on a jetty by a controlled vessel is that due to $0{\cdot}5$ E taking $a = L/4$ and $a + b = L/2$; this will be borne by the bents in a length of jetty $= 2B$. For the whole of the transverse energy to be absorbed by the jetty in one blow the vessel must strike it when nearly parallel or broadside on in ordinary navigating conditions, or when the line of the vessel's centre keelson is in the normal to the line of jetty, or, when the stem of the vessel strikes the jetty, that is any angle between 40 deg. and the normal to the line of jetty ; the two latter cases would be purely accidental or criminal.

Since the above was written the author has commenced a series of experiments with model apparatus to investigate the effects of collisions of water-borne vessels with jetties. On account of the war progress is slow, but one fact seems clear in the case of wood to wood collision. On the average of a number of tests it was found that only $0{\cdot}18$ to $0{\cdot}27$ of the kinetic energy of the vessel is imparted to the jetty in head-on impact. Whilst it is too early to dogmatize this fact explains why many old vertical piled jetties and wharves still stand up to their job.

Example.—A vessel of 10,000 tons approaches a vertical piled jetty with a relative ahead velocity of 2 miles per hour at an angle of 20 deg. to the line of jetty, which is 25 feet wide and has bents of 4 piles at 10 feet spacing.

Ahead velocity of ship $= 2{\cdot}93$ ft. per sec.
Transverse complement of vel$=2{\cdot}93 \sin 20^\circ = 1$ ft., per sec.
Longitudinal complement of vel$=2{\cdot}93 \cos 20^\circ = 2{\cdot}8$ per sec.
Transverse K.E. complement $= 155$ ft. tons.
Effective K.E. complement on blow$=0{\cdot}27 \times 155 = 42$ ft. tons.
Max. effective absorption of energy $= 42 \times 0{\cdot}5 = 21$ ft. tons.

If total compression of the fender system is 12" then the maximum intensity of blow $= 21 \times 2 = 42$ tons. This is distributed over 6 bents of 4 piles each so that the load taken by each pile is $1\frac{3}{4}$ tons. At the same time the max. longitudinal thrust on the jetty from the blow is $0{\cdot}5 \times 42 = 21$ tons, if the co-efficient of friction of the vessel and fenders is $0{\cdot}5$. This latter amount considered in relation to the whole of the jetty is negligible, but in relation to the fender piles which have to transmit it to the jetty it is most important. If the vessel were free it would now move forward along the jetty delivering a second blow broadside-on of the remainder of the transverse energy, or sheer clear and move almost parallel to the jetty. This is normally prevented by engine operation and mooring ropes. The mooring ropes are connected to bollards on the jetty and with a vessel of this size if two ropes are run out the allowance of a maximum pull on each of 25 tons would be ample.

The comparison of these allowances with the computations based on the methods hitherto published may seem too low, but if checked up on the actual phenomena it will be found that they are closer to the truth.

Whilst the structure may be designed to easily withstand the above shocks above river bed level the full effect on the ground must be considered as it actually forms an integral part of the structure.

(To be continued)

Notable Port Personalities

XXXIX—Mr. E. J. Missenden, O.B.E.

Mr. Eustace James Missenden, General Manager of the Southern Railway, who was the successor at Southampton of Mr. G. S. Szlumper, as Docks and Marine Manager of the Southern Railway for three years, joined the former South Eastern and Chatham Railway Company in 1899, and, after holding various positions, was, in 1930, appointed Assistant Superintendent of Operation. He went to Southampton in 1933 and during the period that he he held the position of Docks and Marine Manager, the large engineering works, comprising the building of the new docks and transit sheds, were completed.

Mr. E. J. MISSENDEN, O.B.E.

Following his service as Docks and Marine Manager, he became, in 1936, Traffic Manager, in charge not only of operation but also of the commercial side of the Southern Railway. When Mr. Szlumper took up the duties of Director General of Transportation at the outbreak of war in September, 1939, Mr. Missenden was appointed General Manager during Mr. Szlumper's absence. His permanent appointment to the position was confirmed as from April 1st, 1942.

Mr. Missenden rendered outstanding services in connection with the despatch of the Expeditionary Force to France and the evacuation from Dunkirk. Both these operations necessitated railway movement and port transfer operations of very great complexity, the latter being unequalled in any previous experience.

Mr. Missenden is a member of the Railway Executive Committee which administers the railways for the Government.

Quayside Cranes and other Cargo Handling Appliances at Ports

By J. DALZIEL, M.I.E.E.

(Continued from page 110)

Grabbing Cranes

Grabbing cranes are, in the main similar in their action to coaling cranes, but generally do not require to be of the same high lifting capacity, running in this country usually not in excess of 15 to 20-tons, while they are in most instances considerably less.

Grabs in quayside work are used for unloading bulk cargoes, mainly of coal, and iron or other ores; on occasion, they are used to unload shortlength round timber, such as pit props and logs for paper making; they are also used for dealing with scrap iron, as well as miscellaneous bulk cargoes such as sand, stone and rock, guano, sulphur, etc.; they are extensively employed also for dredging work.

There are various forms of grab, differing mainly in their manner and extent of opening and closing which, in turn, depends on the hinging of the jaws, of which, in general, there are two, pivotted to close on each other so as to form a box. The path of closure should ensure the grab digging into the material it is handling, so as to fill itself effectively, but without setting up avoidable resistance, e.g. by unnecessarily compressing or displacing material.

The oldest and simplest form of grab is that in which the jaws are roughly triangular in cross section, with, of course, closed ends, and are pivotted on a common pin, centrally placed at the apex of their respective triangles, so that they open with a circular movement. The action is then one involving deep digging if the grab is to fill itself adequately, but with no very great downward digging force, the grab tends to rise out of hard or lumpy material; it has also to overcome considerable compressional and displacement resistance. In a later form of grab, sometimes known as the "Clam-Shell" type, the jaws are pivotted and supported approximately at their outside corners, or haunches, and shaped accordingly, being, as in the former case, opened and closed by links, chains or ropes. The action is then more of a scraping one, the mouth of each jaw describing an arc, rising during the latter part of the closure. The "stroke" of the jaws, that is the width of ground covered, is longer than that of the plain grab, and the grab fills itself without digging so deeply and with less resistance; it can accordingly be used further down into the hold without the same risk of fouling the ship's framing beams or other projections.

A further development of this grab is that of Messrs. Priestmans "level-cut" grab, in which compound hinging of the jaws is used; the jaws proper are hinged on pins carried at the bottom of long arms, themselves hinged at the top on a common pin, so that they open and give the grab a very wide range, while at the same time, when closed, the grab is comparatively narrow. The jaws are specially shaped so as, in conjuction with the closing path, to give the effect of digging and cutting through the material rather than scraping it. The arms are so arranged that after the first portion of the travel, during which the jaws are coming into the digging position, the closing path of the grab is practically level. Owing to the power of the grab and to its filling movement just described, the jaws do not require teeth and this, in conjunction with its level closing path, allows the grab to be used practically down to the ceiling of a hold. The collecting area is very wide—up to 17 or 18-ft. or more—and the grab fills itself consistently without incurring any great depth of penetration into the ore. It is thus possible to sink the grab in dealing with an iron ore cargo to 10% greater depth than with clam shell grabs before bringing manually filled tubs into use. It is understood that this grab has shown a greater output per hour over a period of a year of roughly 40% over that given by clam shell grabs of the same rated capacity. Fig. 8 shows this grab in its various stages of closing, and Fig. 9, an actual discharge of coal.

On ordinary grabs for coal, sand, etc., the mouths of the jaws are plain plates so as, in the case of coal, to avoid breakage, but for handling ores containing hard and large lumps, tines or teeth are fitted. Even so, the grab is frequently held open by such lumps, so that the fine material leaks out and may be lost; in such circumstances, the grab should be emptied and refilled. The

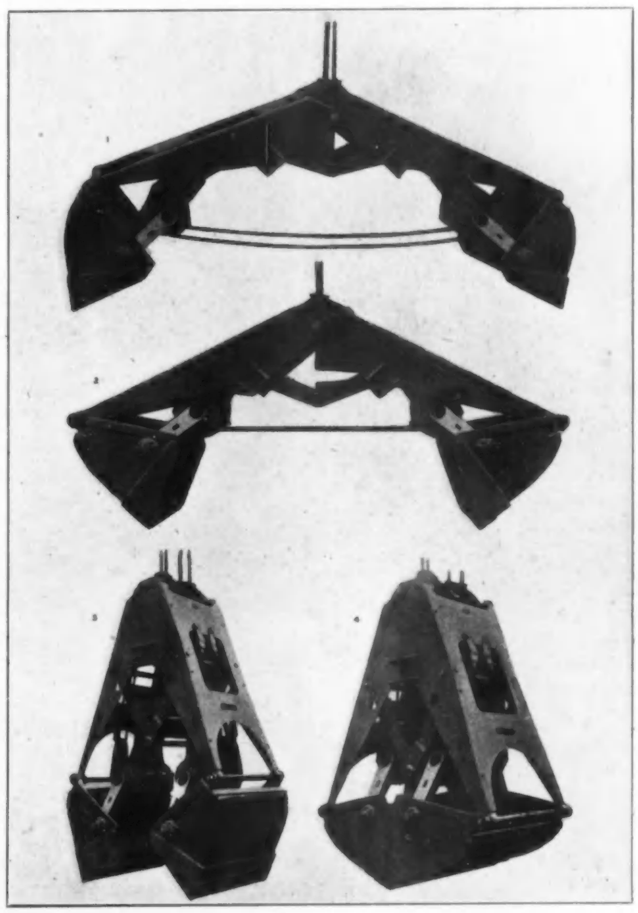


Fig. 8. Level-cut Grab in various stages of closing. (Priestman Bros.).

same appplies to an even greater extent in dealing with scrap iron. To overcome or, at least to reduce, this trouble grabs are made with four up to six or eight jaws each having sufficent independence of movement, e.g. by embodying some springiness in their closing levers and in the sectional jaws themselves, as to allow the others to close satisfactorily if two are held open by a lump or piece of scrap; such grabs in the writer's experience, are apt to be less robust than the two jaw type and more costly in maintenance, but fulfil their designed purpose fairly well. In the Priestman grab of this type known as the "Cactus" (illus-

Quayside Cranes at Ports—continued

trated in Fig. 10) it is understood that these difficulties have been overcome.

Grabbing is a very exacting service both on the crane and the grab as, besides the strain put on both in course of hauling out of the general body of the are, lumps which may be large enough to cause overload, the grab may catch on framework girders or other portions of the structure of the ship; this will bring out the overload cut-outs of the lifting motor or motors, but it has to be remembered that these operate only *after* the strain of the overload has been imposed on the crane. Both cranes and grabs should, therefore, be built with a very ample margin of overload capacity and should be specified accordingly.

The prevalent method of working grabs is the two or four rope; one rope or pair of ropes—the holding ropes—lift and support the main weight of the grab, the other or other pair—the closing ropes—are used for opening and closing the jaws. These latter are in modern practice passed round a pair of pulleys or sheaves, the movable one of which is coupled to the links or levers working the jaws.

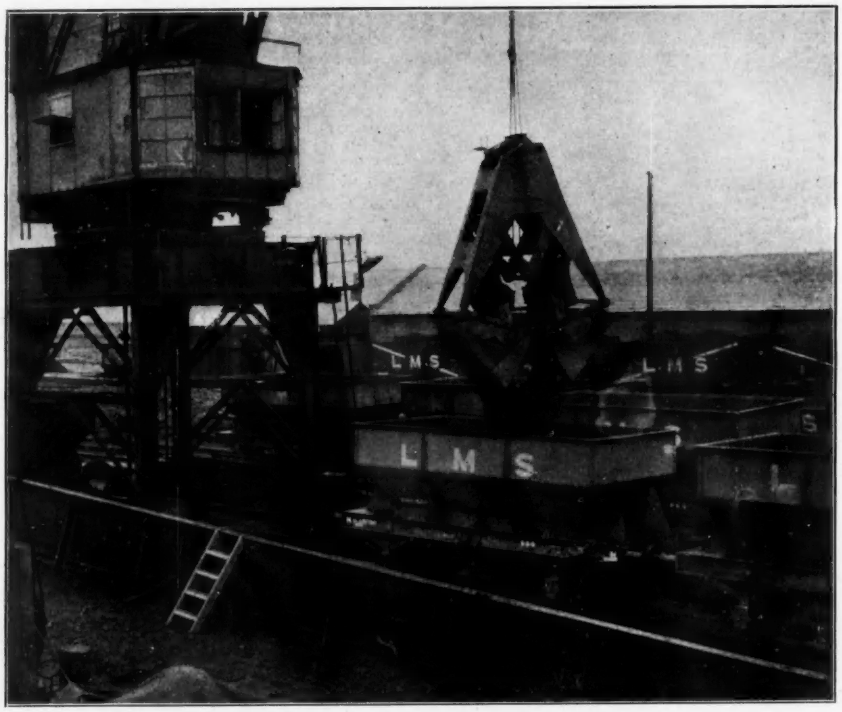


Fig. 9. Grab Discharging. (Priestman Bros.).

The effect of the sheaves is to give purchase to the ropes in the direction of closing the jaws rather than lifting the grab and the amount of purchase may, of course, be varied by varying the number of falls of the rope. The two sets are, as in the case of coaling cranes, worked from separate winch drums which are coupled together or freed from each other, as the case may be, at appropriate times.

When coupled together, both drums take part in lifting or lowering the grab, and it will be seen that the motions and their action are more or less identical with those of coaling cranes. With grabbing cranes, however, it is even more necessary to ensure that the two winch drums work in exact synchronism than with coaling cranes. For example, if the holding ropes take too much of the load, the closing ropes may be slackened and so allow the grab to open and spill the ore or coal; if they take too little, the closing ropes and winch will be overloaded to a greater extent than with a coaling crane's tipping winch.

It is, of course, the holding rope winch that is declutched as the closing ropes are in action opening or closing the grab while the holding ropes are taking the main weight and keeping the grab in position. When both are in movement, the two sets of ropes must work at the same speeds to avoid slack ropes; the primary clutch is generally a friction clutch, but to obviate any possibility of the grab opening or closing improperly, it is usual also to couple the two barrels solidly through a positive clutch which can be engaged or disengaged at will.

As with coaling cranes, the winch drums may be driven by one motor and coupled or *vice versa* through friction clutches; the writer has used this method successfully, but (also as in the case of coaling cranes) for the sake of speed and simplicity in operation, would prefer to drive the two drums independently by separate motors inter-connected, so that when lifting together, they work at the same speed and share the work equally, which of course, infers that they should be of equal power.

An arrangement corresponding to that of some coaling cranes of lifting through a sheave and winding one end of the tipping rope round the lifting rope drum, is not applicable to a grabbing crane as the sheaves and their double ropes would be impracticable.

The action either with single motor and clutches or with separate motors to each winch is that the grab is lowered on to the ore with the jaws open, the two drums acting together.

The drums are then uncoupled and the closing rope drum is worked in the lifting direction alone, under which circumstances it, of course, closes the jaws.

When the jaws are closed home and the closing rope begins to take the weight of lifting, the lifting drum is coupled up to it and started and the grab raised to the required height and moved to the discharging position, which may be direct into a wagon or into a hopper under which the wagons pass for loading.

The latter arrangement permits of grabs of larger capacity being used than when direct loading into wagons is to take place, as the wagon restricts the dimensions of the grab if spillage is to be avoided, also in an ordinary train of wagons there may be many incapable of taking the load of a single grab of high capacity.

Discharge of the grab takes place by a reversal of the motions of loading, that is the grab is lowered, as necessary, and its weight taken by the holding winch at an appropriate height above the wagon hopper, the rope of the closing barrel continuing to be paid out and allowing the jaws of the grab to open.

With a single motor and clutch operation there is little or no liability to the grab not being properly closed, so far as the working of the lifting and closing mechanisms is concerned. Even lateness in clutching in the holding winch in lifting is unimportant, as the single fullpower motor can just as well lift through the closing winch and it is necesary to clutch the former in on completion of closing only to keep the ropes from slackening.

As already suggested, however, with winches having separate driving motors, matters are in a different category. To keep the two in synchronism and obviate premature opening or closing of the grab, special electric inter-connections between the motors must be provided. These on the crane by Stothert and Pitt for the L. M. & S. Railway, illustrated per Fig. 4 (*ante*) are typical and are as follows:—

In the circuit of the closing motor is a jamming relay inserting resistance in the rotor circuit, in the event of overload such as may be due, for example, to the grab closing on a framework beam, or to other cause.

When lowering the empty grab the holding line takes the whole weight as, with the grab open, the closing line ropes are slackened. The holding motor is overhauled, brakes regeneratively, and

Quayside Cranes at Ports—continued

therefore runs slightly above synchronous speed. The closing line motor, not taking any weight, runs at practically synchronous speed and pays out its ropes accordingly, but to compensate for the difference in the respective motor speeds, the winch for the closing ropes is geared for them to run 5% faster than the holding ropes for equal motor speeds. On empty grab lowering, therefore, the closing ropes are paid out at the same speed as the holding ropes, notwithstanding the weight on the latter, and the tendency for the grab to be prematurely closed is avoided.

In lowering the full grab, resistance is inserted in both the rotor circuits and is so proportioned as to give approximately equal pull and speed on both sets of ropes, both motors being overhauled and braking regeneratively.

In lifting the full grab, just as the closing ropes are completing their work, the holding controller is set to "hoist." If moved too late, or if the holding motor does not accelerate fast enough, so putting overload on the closing motor, winch, and ropes, the jamming relay above mentioned inserts resistence in the closing motor rotor circuit and slows it down until the holding motor takes up its load. Some resistance must be retained in the rotor circuit of the closing motor, during lifting, to relieve it of the extra load it would otherwise take, owing to the higher speed for which its ropes are geared.

As regards other features of the Stothert and Pitt crane Fig. 4 (*ante*), braking in lowering is effected by the counter current method, which is the A. C. counter-part of D. C. potentiometer lowering and which will be described later. The under-carriage design and the method of getting the required height are noteworthy. The crane covers three lines of rail track, the moving superstructure being centred near the seawards end, and is carried on eight wheels, four of which are driven, on the seawards side, and four wheels, two driven, on the landwards side; travelling speed is 40-ft. per minute.

The crank and the connecting rod luffing mechanism, the arrangement of jib and balance weight, and the level luffing rope layout, are seen in the photograph. The crane is of 10-tons rated capacity for grabbing, the grab being level cut or scraper type, having an extreme opening width of 17-ft. It can also be arranged to lift ordinary loads of up to 5 tons on the holding ropes, in which case the closing ropes are disconnected from the grab and attached to a trolley running on two taut ropes under the jib. The range of lift is 50-ft. above and 22-ft. below quay level at 150-ft. per minute. Range of rake 28 to 74-ft., luffing at 200-ft. per minute, and slewing at 500-ft. per minute.

Ring Discharge Single Rope Grabs

Another form of grab, generally used in smaller sizes, is the "Ring" or "Bell" discharge single rope grab which has the advantage of being adaptable to any crane of ordinary design used for other purposes. Its jaws are closed by the lifting rope being passed over a set of sheaves, as with the closing rope of two rope grabs, the number of rope falls being such as to give the desired closing purchase.

Discharge is effected by the action of the "Bell" or "Ring," which is supported by two chains or ropes attached generally to the jib head; these may be linked up to any desired height of discharge, but once set, discharge takes place at a constant level. In some cranes however, these ropes supporting the discharge ring are carried over pulleys at the jib head into the driver's cab, and there attached to a hand or power operated winch, so enabling height of discharge to be adjusted at any time as required. The winch must be capable of carrying the full weight of the grab, but need only be powered for lifting or lowering the discharge ring. It is advantageous with such an arrangement that the level luffing gear of the crane should be of a type requiring a single pass only of the lifting rope to the jib head; as the discharge ring should likewise luff level to obviate inadvertent discharge when luffing.

When the grab is lifted into the discharge ring, a hook falls over, whereupon the grab is slightly lowered to engage this hook with the ring so that it takes the weight of the grab; further lowering allows the grab to open and discharge. At the same time in one well-known make of grab, a suitably shaped casting attached to the hoisting rope passes down through, to just below (with the grab full open), a tumbler shaped to pass it, and connected to the hook above mentioned. The grab is then swung back over the ship open to re-load, when it is released from the discharge ring by slightly lifting the hoisting rope, the casting on which then, in the upward direction, engages with the tumbler, takes the weight of the grab and leaves the engaging hook to fall clear of the discharge ring, whereupon the grab can be lowered for re-loading.

It should not be allowed to fall violently on the material to be dealt with; a free fall of a foot or thereby will be sufficient to enable the grab to load itself fully. In view of the slackening of the ropes as they are relieved of the weight of the grab, some protection against their coming out of position on the winding drum may be desirable.

One disadvantage of this type of grab is the long length of rope required to operate it, height of lift being lost accordingly.

Warehouse Cranes

Where the quayside cranes deliver into warehouses, the latter must be provided with crane equipment. These cranes in earlier days when in the case of most installations they were of minor importance, were fixed jib cranes in large numbers placed at frequent intervals throughout the warehouse. In modern practice many of these have been removed on account of the objection to them by reason of the obstruction they cause on the platforms and the space they take up.

Of late years, particularly where stacking is necessary, overhead travellers have been used. Also in some instances other appliances have been installed as for example, transporters, having a crab running on a long single girder extending from outside the warehouse over the point where the load is deposited by the quayside crane, to the back wall. The disadvantage of this appliance is that it has no lateral movement lengthwise of the warehouse.

Overhead cranes are frequently fitted with underhung jibs or similar devices enabling them to pick up loads lying beyond the area underneath the gantry rails on which they run. The jib may, for example, be protruded through a doorway to pick up from the depositing point of the quayside crane.

In multiple bay warehouses, it is also possible to pass loads from crane to crane across the warehouse, though this is not a process which would be used normally, as it would be very slow and at the same time would occupy two or more cranes which would most probably be required for other purposes.

Overhead cranes are of course very mobile laterally; at the same time, their mobility, to some extent, is more apparent than real, as, if they have to travel any distance with the load, the staff are kept standing by idle till they return. They are, of course, unable to pass each other, and where two or more are installed in the same bay, loads requiring to be moved from end to end of the shed may have to be handled by at least two cranes, or if by one only, the others will have to go out of action meanwhile. There should not commonly be such loads and the cranes and the flow of traffic should be so arranged that the former have mainly to do cross deck movements with only limited lateral movement.

Fixed jib cranes may be of the pedestal type, self-supported on the floor, or preferably should be of the pillar type supported from the roof, or by tie rods from the walls, which permits of a considerably cheaper, less elaborate, and lighter construction.

An alternative crane to the overhead, requiring less head room and dispensing with expensive gantry and other supports, is a development of the latter type; this is the "Walking" crane, which is a jib crane running on a single rail down the deck, or bay, and held upright by a channel or other form of girder in the roof above, braced against the side stresses of the jib and its load. The jib can be given a considerable rake, sufficient to cover a normal width of deck and be able in addition to protrude through a doorway to pick up loads deposited from the quayside crane. The "Walking" crane is fitted with lifting, slewing, and travelling motions, but as with the overhead crane, when despatched with a

Quayside Cranes at Ports—continued

load, it keeps the staff waiting for its return and its main usefulness is across the deck.

A development of this type of crane, with the evolution of which the writer was associated, was installed in a Goods Shed in parts of which the roof was low and in which the flow of traffic varied between deck and deck at different times of the day. It was necessary to deliver into box vans and also to be able to stack high up where the roof was high enough. These rare requirements were provided for by the jib being luffed. A number of cranes were installed, and their travelling rails and jib-head girders were carried over portable platforms put down as occasion arose to join up the decks.

On the decks themselves, travelling rails and overhead girders were duplicated in places and fitted with points, so as to provide passing places where two cranes could meet and pass, the travelling wheels of the cranes being pivotted so that they could take curves, thus enabling an empty crane to come back to the loading point shortly after the despatch of the loaded one.

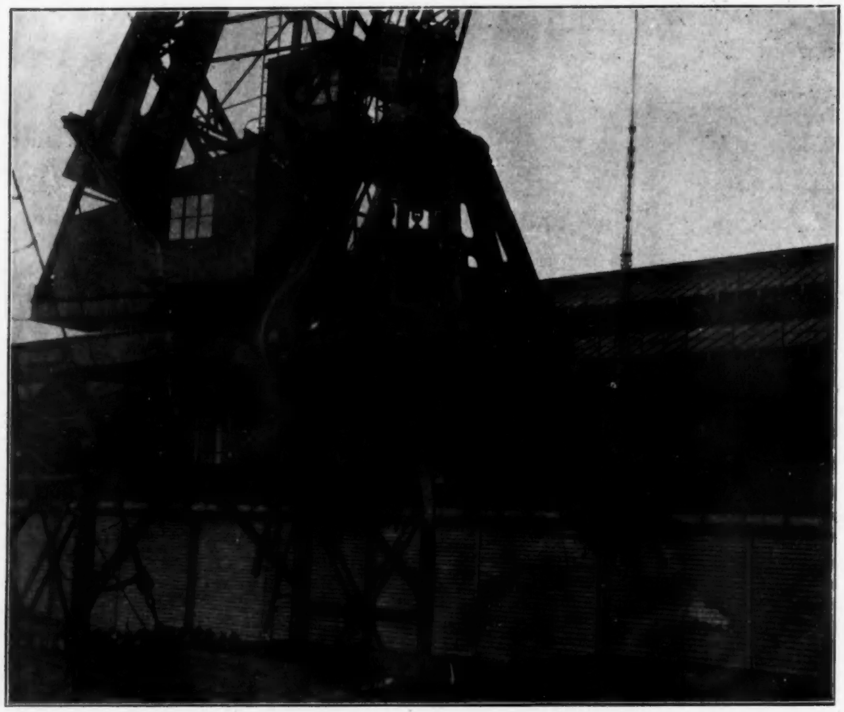


Fig. 10. "Cactus" Grab. (Priestman Bros.).

Current supply was simplified by using a rectifier giving D.C. from a three phase supply, earthing one pole to the travelling rails and using a single trolley wire.

It was possible to concentrate all or most of the cranes on the busiest platform for the time being by passing them over the inter-connecting platforms.

A development of the transporter is used for long distance transport for handling cotton bales, for example, from ship to warehouse. The track consists of an "H" girder carrying a crab (or crabs) fitted with electric lifting and travelling gear, which picks up its load at the quay and carries it into the stacking shed where it passes on to a corresponding "H" girder carried on an overhead traveller, which runs lengthwise of the shed to deposit its load at any point required, thereafter returning empty.

In general, such transportor or conveyor crabs carry their own operator, but they can, of course, be worked by ropes or chains from ground level. They can be provided with passing places in the "H" girder track, or could, if necessary, be arranged to return throughout on a completely independent track, so permitting of a continuous flow of traffic.

The self-contained mobile crane is a development of recent years which, while it may not be so applicable to dock and harbour yards as to railway goods yards, is a convenient form of appliance for dealing with lifts which might otherwise require a considerable amount of shunting to bring them within the range of a fixed crane. These cranes are, in practically all circumstances, worked by internal combustion engines driving a dynamo from which the motions are electrically operated.

Lifting and travelling are always provided. Slewing, or its equivalent, is provided in some cases by manipulation of the travelling wheels and steering gear, more effectively in some makes than in others. In some cases, the wheels can be set also to give a side motion. A slewing jib is available on some cranes of fairly high capacity. The capacity of such cranes is up to 6 tons; so far as the writer is aware, this is not exceeded.

The rake is necessarily very short and there is no necessity to work any motions at high speed, the chief point to watch about these cranes being their stability.

Cranage for multi-floor warehouses is still done in many instances by hydraulic jiggers, or hoists, which work a wire lifting rope, or chain, over a pulley projected by a girder, forming a sort of jib, a short distance outside the warehouse wall and over a " deck " outside the doorway on the top floor and serving this and a series of similar doorway " decks " on each floor vertically below it, the " decks " not in use being triced up.

The rope is, of course, worked as usual by ram and multiplying gear and, occasionally, the jub pulley may traverse for landing the load inside the warehouse; this, however, is only effective on the floor immediately under the jigger and landing is mostly done by swinging the load into the doorway.

The corresponding electric appliance is the friction hoist which may be direct driven by a self-contained motor or may be driven by shafting run by a motor or, alternatively, by a gas or oil engine, or a steam engine. Electric drive has superseded the other alternatives in many cases. Previously, the gas engine prevailed, steam only being used where it also served other purposes.

Where there are a large number of such hoists with extensive shafting, it is best to break up the shafting and put in a number of motors in order to save power in idle running. The motors can readily be remote-controlled, or even arranged to stop automatically after the lapse of a certain period of running without load.

The friction hoist is a very simple and efficient appliance, embodying a lifting drum and, in general, a large diameter flat faced pulley on the same shaft.

A second shaft running continuously while the hoist is in service and mounted in suitable relationship to the first mentioned shaft, carries a friction drum of paper, fibre, raw hide or similar material.

The lifting drum is eccentrically mounted, so that by pulling a hand rope it is moved over to engage the large pulley with the friction drum, so that it is driven for lifting; with the release of the hand rope fully, the pulley falls back on to a brake shoe so that the load is held; to lower, the pulley is held intermediately clear of both friction drum and brake, being let back on to the latter as necessary for the control of lowering speed. The pulley and friction drums are sometimes both of metal with interlocking grooves cut in their faces. The control rope, of course, passes from floor to floor and is worked from any floor.

With independent motors, these hoists can be remote-controlled as regards the electrical gear, as well as the control rope; for example, the motors can be started and stopped by

Quayside Cranes at Ports—continued

push button, or can be arranged to start automatically when the control rope is pulled, and to stop when it is released.

Hoists are also occasionally fitted with motors coupled solid to the lifting drum and fitted with electric remote control and solenoid operated brakes.

Shipboard Cranes

Shipboard cranes may be dealt with briefly, though they hardly come within the category of this article. They are largely of the derrick type, working from winches on the deck, sometimes by loose ropes, coiled over an open ended horizontal bollard and sometimes by a fixed rope on a drum.

Frequently, there is a centre drum with fixed rope for lifting plus an open ended bollard at each end of the main shaft, from which loose ropes luff and slew the derrick post.

In some of the most modern ships a winch is provided for each motion, but three winches to each derrick take up a lot of deck room.

Electric winches are usually worm-geared and very silent. They can be operated by controllers, placed to give a view direct into the hold and fitted to give electric braking of one of the types later described, without being themselves placed in the very near vinicity of the hatch coamings. A direct foot brake for emergency use is desirable where possible. Jib cranes are also fitted on shipboard. They are very frequently of the self-supporting pedestal type, but it is generally possible to get top and bottom support from deck and bulkhead for the centre post, and this is a general form of design and is a lighter and better arrangement than the former, when feasible. In addition to the lifting motion, power slewing, and frequently luffing, are fitted.

The jib is generally stowed away, either by being laid down on rests on the deck, or by luffing it right up; with the latter, care must be taken that it responds at once to any slackening of the luffing ropes for the purpose of letting it down, otherwise the ropes may be slackened down excessively without response, so that when it does come down, it falls free for a space and is brought up with a snatch on the ropes, or it may be hung up for some time and come down unexpectedly and dangerously. There is also liability in such circumstances to the ropes coming off the winding drum and being damaged by getting round the shafts or entangled in the gearing. Some of these cranes are fitted with level-luffing, but for reasons indicated this is not entirely desirable.

Machinery is generally housed below the cranes between decks, the centre post, electric cables and ropes only coming up through the working deck in watertight stuffing boxes. The machinery must be very compactly assembled.

Remote control, with contactors for both starting and braking, saves deck space and facilitates operation, but the motors are by no means too large as a rule for ordinary tramway or drum type controllers if these can be accommodated.

Even though these appliances are invariably D.C. they generally present a special problem in getting light load speeds fast enough to satisfy requirements in conjunction with moderate heavy load speeds and the motors are generally compound-wound with portions of the field windings weakened or cut out for the lighter loads, as is done for example by one of the control methods about to be described.

(To be continued)

Port Aid Centres at Glasgow.

Port Aid Centres, where workmen employed in any way on harbour work can receive immediately attention after an accident, are being established at the Glasgow Docks, by the Clyde Trustees, and work has already started on the proposed six centres. While existing first-aid services are recognised as very efficient, the opinion is held by the Trust that the timely treatment of injuries received in accidents will result in a considerable economy in manpower and that larger services are therefore needed. An appropriate grant has been approved by the Ministry of War Transport towards the capital and running costs of the new Port Aid Centres.

Mombasa Harbour Board

Constitution of East African Port Authority

An interesting account of the inception and working of the Harbour Board at the Port of Mombasa, Kenya, is contained in a letter which appeared recently in the *Natal Mercury* which we take the liberty of reproducing below:

Sir,—Apropos your editorial dealing with the Durban Harbour Advisory Board, it may be of interest to your readers to know how a similar Board, with seventeen years of outstanding success behind it, has functioned. I refer to that of the East African Port of Mombasa.

When the late Sir Christian Felling—then a senior officer of the South African Railways and Harbours Administration—went to East Africa as General Manager of the Kenya and Uganda Railway, he found that the Port of Mombasa was seriously inadequate for the needs of the rapidly developing territories which it served; that its functioning was chaotic, having no coherent management; that it operated on no clear-cut financial foundation, and had no planned revenue basis.

He early put the following in train:—

(a) The development of a port construction and development programme, to cost some £3,500,000, comprising a deep-water quay, oil and coal berths; together with electrical and marine equipment.

(b) The formation of a Port Department reporting directly to himself (but entirely independent of the Railway Transportation Department) and the appointment of a Port Manager.

(c) The separation of Port and Railway finance and accounts.

(d) The constitution of a Harbour Advisory Board whose functions should parallel as closely as practicable (under Government ownership of the port) those of a board of directors.

I had the privilege of being the first Port Manager appointed under Sir Christian Felling's port organisation, and was in charge at Mombasa from 1926 to 1932.

The Mombasa Harbour Advisory Board comprises:—

A permanent Chairman (the Commissioner of Customs for Kenya and Uganda who resides at Mombasa).

Two shipping members (these to have no commercial interests other than shipping).

Two members appointed by the Mombasa Chamber of Commerce.

Two members appointed by the Kampala Chamber of Commerce.

One banking member (the managers of the two Mombasa banks in annual rotation).

Secretary (a man having economic and statistical experience).

It will be noted that the Chairman is the only Government member; all the others represent private enterprise.

The chairman receives an annual honorarium for his services; members receive a modest fee for each meeting which they attend and the Secretary is a paid Government servant.

The Port Manager prepares agenda for the Board's meetings, together with an advance memorandum concisely explaining each item. This enables members to arrive prepared at meetings. The Port Manager attends all meetings without vote. He is, in fact, the Board's intelligence officer in this respect. He answers questions, supplies information and, of course, puts forward his own views and proposals as the senior executive officer responsible for the day to day working of the port ashore and afloat.

The minutes of the Board pass through the General Manager of the Railway (in that officer's capacity as chief adviser on port matters to the Government) to the High Commissioner of Transport for Kenya and Uganda.

In general terms, the functions of the Mombasa Harbour Board include:—

(i) The framing (in 1926) with the assistance of the Port Manager, of an entire port tariff of charges, which, while encouraging the country's development and avoiding any undue burden upon commerce or shipping could be expected to produce an annual port surplus over and above all expenditure and charges after an initial period of years.

Mombasa Harbour Board—continued

(ii) The framing of Port Regulations.

(iii) Recommendations on all subsequent amendments of (i) and (ii).

(iv) Recommendations in respect of the Port Manager's port organisation and any subsequent amendments.

(v) Recommendations in respect of port labour contracts for handling cargo as between ship and shore.

(vi) The critical examination of the Port Manager's draft port estimates for each successive year and their recommendation in final draft form. (This is effected by a sub-committee of the Board which reports to the full Board with recommendations).

(vii) The constant review of port development in respect of requirements with progressive recommendations based upon long-range planning.

While the minutes of the Board are not made public, there is no mystery of secrecy about its deliberations. Close contact exists between the Board, the Chamber of Commerce and the Town Board. (Members are also members of one or both of the other two bodies). The actual minutes of the Board are printed in book form annually, when, no doubt, they are seen by persons interested.

When Port Manager, I consulted the Board on a great variety of current issues. I found it a tower of strength, and an invaluable guide to public requirements and opinion. From the outset the Board took its responsibilities seriously, and with enthusiasm for the efficiency and good standing of the port, which has shown a surplus over all charges since 1936. That its operation has won the approval and confidence of the public is apparent from the East African newspapers.

The Mombasa Harbour Board, by its alertness and painstaking work, has exercised almost executive authority (as any Advisory Board can do if it so desires). I do not think that any recommendation of the Board has been negatived. There was none during my tenure of office.

G. V. O. BULKELEY.

Post-war Pilotage

United Kingdom Pilots' Association Conference

At the 57th Conference of the United Kingdom Pilots Asssociation to be held in London on September 29th and 30th (at a time when this issue will be at press), a number of resolutions are down for consideration and one of the most important items on the Agenda concerns the question of post-war pilotage. The matter is the subject of a letter from Mr. S. S. Wilson of the Ministry of War Transport dated June 25th last, a transcription of which is as follows:

"I am directed by the Minister of War Transport to refer to the informal meeting at this office on April 16 last, which was attended by representatives of the United Kingdom Pilots' Association and the Chamber of Shipping, about pilotage matters generally, when the suggestion was canvassed of a uniform percentage increase in rates in all pilotage districts to go into a common fund from which payments might be made to pilots in districts where earnings were initially low and had fallen below pre-war levels. This suggestion has now been considered by the Government Departments concerned, and as a result the Minister is advised that it is doubtful whether effect could be given to any such suggestion by means of a Defence Regulation.

"Apart from this point, however, the Government is not clear that special treatment for pilots could be justified. Their position in the matter of remuneration does not differ esentially from that of many other workers and in particular from that of numerous shopkeepers and others whose earnings are fixed directly by way of margins regulated by the Ministry of Food and where the general rule is that there can be no compensation for loss of business. The income of some pilots is reduced because there is less work to do. Nevertheless, in spite of the general rule, the Minister has taken into acount other factors and has in some cases permitted increases in rates although the amount of work has decreased. The national interest is to ensure that the residue of work is done and that a skeleton organisation is preserved for the post-war period, but the Government could not normally guarantee pre-war earnings either by a subsidy or by allowing a general increase in the pilotage rates and charges in all districts.

General Policy

"So long as the Pilotage Act, 1913, is operative (and the Minister sees little likelihood of introducing amending legislation during the war) it will be the Minister's general policy to follow that hitherto adopted, namely, subject to consideration of special circumstances and of any objections lodged, to confirm by-laws submitted to him for particular districts to increase the pre-war rates by not more than 100 per cent., the general guide being, in such cases, to restore net earnings to approximately the average of those in 1936-7-8. In cases where earnings are low the Minister has been prepared to consider sympathetically applications to increase rates so as to bring net earnings somewhat above the pre-war figure. The general guide which the Minister has had in this connection is the policy of the Government towards its own servants in the matter of increased remuneration to compensate for wartime increases in the cost of living. The maximum salary in respect of which such increases are granted has recently been raised and the Minister will, of course, take this fact into consideration in dealing with future applications.

"While the above must continue to be the general policy of the Minister, he would be willing to review it in the light of any agreed recommendations (whether general or in regard to particular cases) which those concerned put before him, provided that those recommendations do not require legislation and are not inconsistent with the Government's policy.

Post-War Position

"As regards the post-war position the Minister is inclined to the view that some revision of the Act of 1913 would be desirable and he trusts that pilots, shipowners, the Corporation of Trinity House and port authorities are now considering the lines which amending legislation should take when the time is opportune. Among the points to which attention will doubtless be directed are:—

(a) Whether the present system of compulsory pilotage in some ports, and in parts of others is still desirable.

(b) Whether pilots should retain their present status or should become the regular employees of some central body or local bodies.

(c) Whether the present system of payments to and from benefit funds needs review.

(d) Whether pilot boats should continue to be privately owned or should be taken over by pilotage authorities and maintained by them.

"This letter is being addressed to the Chamber of Shipping, the United Kingdom Pilots' Association, the Transport and General Workers' Union, the Corporation of Trinity House and the Dock and Harbour Authorities' Association."

Göta Canal Company.

The report of the Göta Canal Company for the year 1942 shows that the navigation season was the shortest on record, namely, from May 5th to December 5th. Passenger traffic was inconsiderable, and for the same reasons as in 1940 and 1941 other traffic was on a greatly reduced scale, being only about half of normal. Maintenance work on the canal, bridges, buildings, etc., cost 73,140 kroner, against 81,380 kroner. Forestry work showed a profit of 148,020 kroner, against 109,703 kroner, and the work of the saw-mills a profit of 5,647 kroner, against 7,593 kroner. The accounts close with a profit of 55,850 kroner, against 45,590 kroner, which is transferred to contingencies fund, which, after providing 92,652 kroner for the 1941 dividend, amounts to 1,990,000 kroner against 2,010,000 kroner. The directors propose to pay a dividend at the rate of 3 kroner per first-class shares and 2.25 kroner per second-class share, requiring a total of 92,652 kroner, which is to be taken from the contingencies fund.

Notes of the Month

National Council of Port Labour Employers.

Following the retirement of Mr. C. Cullen, Mr. D. F. Macdonald has been appointed Secretary to the National Council of Port Labour Employers.

Colombo Port Commission.

The Colombo Port Commission has recently suffered by death the loss of two members, namely, Mr. R. Sri Pathmanathan and Mr. C. I. Pocock. Tributes to their services, while on the Board, were rendered at the last meeting of the Commission.

London Dock Strike.

A strike involving 120 London dockers which occurred at the beginning of September, was concluded after a stoppage of several days. The dispute was unofficial, and arose from the alleged withholding of attendance money to some individuals.

Opening of New Lock on the Sault Ste Marie Canal.

A large new lock on the Sault Ste Marie Canal, Canada, was brought into operation on July 11th. It supplements the work of the three existing modern locks through which large ore and grain ships move from Lake Superior into the St. Mary's River and thence to Lake Huron and other ports of the Great Lakes.

Tyne Improvement Commissioners.

At the last monthly meeting of the Tyne Improvement Commission, Mr. Arthur G. Everett was appointed a member to fill the vacancy caused by the resignation of Alderman R. S. Dalgleish. This fills a vacancy in the shipowners class of dues payers and Councillor Ronald H. Scott becomes Corporation representative in place of the late Alderman David Adams.

P.L.A. and L.C.C. London Reconstruction Proposals.

The detailed arrangements connected with the riverside and dockside communications in the recently published proposals of the London County Council for the reconstruction of London, have been submitted to the Port of London Authority for their observations; the Chairman of the Authority (the Hon. Thomas Wiles), has been appointed Chairman of a Committee to deal with the matter.

Ship Fires at Liverpool.

Mr. J. Clitherow, Commander of the N.F.S. Force which deals with Merseyside ship fires, states in his review of the past year that there were 79 ship fires in the Port of Liverpool, as compared with 73 in 1941. Of those fires, 14 were due to sparks, 11 to blow lamps and cutting apparatus, 10 to dropped lights, 7 to spontaneous ignition, 5 to oil fuel, 4 to electricity, and 3 to various kinds of overheating. In 12 instances, the cause of fire was not discovered. During the year, a 70-ft. long vessel has been added to the Mersey fireboat flotilla and a monitor allocated to the Manchester Ship Canal.

The Institute of Transport.

The President of the Institute of Transport (J. S. Nicholl, Esq., C.B.E.), entertained members of the technical press to luncheon in London on the 14th September and, in the course of an address of welcome, described the functions of the Institute in their relationship to the development of transport. He indicated the advantages to be realised by the co-operation of the technical press in disseminating information on the activities of the Institute and laid particular stress upon the essential unity of the whole transport system by land, sea and air, in serving the commercial and industrial interests of the country.

The Presidential Address for the coming session of the Institute will be delivered by the President-elect, Sir William Wood, on October 12th at 5 p.m. at the Institution of Electrical Engineers, London.

Closing of the Port of Barcelona.

Under an Order issued by the Barcelona Port Authority, only persons actually engaged in port services are allowed to enter the port area.

Royal Visit to London Docks.

On the 27th August King Peter of Yugo-Slavia made a tour of the Docks of the Port of London. He was accompanied by the Chairman of the Port of London Authority, the Right Hon. Thomas Wiles and the party included a number of Yugo-Slavian Officials and Army Officers.

Naval Officers' Hostel at Liverpool.

The Mersey Docks and Harbour Board have taken the former residence of Mr. John Rankin, St. Michael's Mount, Fulwood Park, Liverpool, for the purpose of converting it into an establishment for the accommodation of Naval Officers who are on leave in Liverpool and are unable to go home.

Belfast Harbour Lights.

The Belfast Harbour Commissioners have acquired a new light and pilot ship which is to be named after Lady Dixon. The Dixon family have been connected with the Trust during the past 60 years, the record beginning with Mr. Thomas Dixon, followed by Sir Daniel Dixon and later by Sir Thomas Dixon.

California Association of Port Authorities.

At the recent annual meeting of the Californian Port Authorities held at San Francisco, Mr. Arthur H. Abel, Port Manager and Chief Engineer of the Port of Oakland, was elected President for the coming session. He succeeds Mr. John L. Kelly, of Long Beach.

Retirement of Port Official.

In consequence of ill-health, Mr. C. C. Brewer, Clerk to the Newport (Mon.) Harbour Commissioners, has tendered his resignation. Mr. Brewer has completed nearly fifty years' service with the port, having been appointed clerk in succession to the late Mr. Phillips. He is also secretary to the Newport Pilotage Authority and Collector of Harbour Dues.

Expansion of Dry Dock Undertaking.

It is announced that the Port Talbot Dry Docks and Engineering Works have been acquired by the Prince of Wales Dry Dock Co. (Swansea), Ltd. The dry docks now under the control of the latter Company, comprising the Prince of Wales, Palmer's and Port Talbot Dry Docks, are capable of dealing with the largest oil tankers and cargo boats afloat.

Increase of Draft on the St. Lawrence.

A Canadian Government announcement states that the recommended draft for vessels operating on the St. Lawrence Canal System has been raised to 14-ft. 3-in. with a view to increasing the load carrying capacity of shipping on the Canal to meet the great demand for water transportation of raw products for Canadian war factories.

Sailors' Centre At Greenock.

A Hostel for Seamen of all the allied nations has recently been opened at Greenock as a memorial to the work which these men had done in the Battle of the Atlantic. It has been named the Inverclyde Centre as a tribute to Lord Inverclyde who, as chairman of the Scottish Advisory Committee of the British Sailors' Society, has done an immense amount of work in the ports and harbours of Scotland for the men of the Mercantile Marine. At the opening ceremony, Provost Morrison, of Greenock, said that Greenock, which many had regarded as a city with a past but no future, had shown in this war, as had other West Country ports, that it had a future far more glorious than anything which had been seen in the past.

Developments in Modern Tiering Trucks for Cargo Handling

By A. G. AREND.

Nature of Operation

It is doubtful if at any previous time a greater demand has been made for expeditious handling of goods at the dock side than at present, and hence all improvements in equipment used are worthy of, at least, some consideration. The electrically-driven tiering truck has only enjoyed limited application in this country, although it has been much more widely utilised abroad, and particularly in the United States of America. The same cannot be said of the ordinary battery truck, which has enjoyed wide popularity in this country for some years past. Tiering trucks differ essentially in that provision is made for both vertical and horizontal conveyance, whereby both time and space are saved, not to mention a direct monetary saving. This is seen in its most extreme form where goods have to be discharged and reloaded. Even at the present time, despite the severity of the war conditions, platforms, loading banks, and freshly-erected stages are to be seen literally packed with goods which have, later, to be re-loaded, which means that intermediate handling has been necessary in order to set free other storage space. Where a sufficiency of modern electrically-driven tiering trucks is available, neither intermediate treatment, nor the use of upraised constructions is necessary. This work is, of course, further assisted where ramps, or corresponding floor recesses already exist, as these render the system of working still more flexible. In earlier years, tiering trucks were more or less limited to the handling of piece goods, boxes, drums and other containers, etc.

To-day, they are widely utilised for the immediate transference of bricks, refractory blocks, small castings, and innumerable other goods such as coiled strip, cable, wheels, etc. The ordinary battery truck is of too light construction to permit of liberties in the way of elevating appreciable weights, and in any case, lacks a sufficiency of power. The modern electrically-driven tiering truck differs in this respect, as current is brought into it by plug contact with the assistance of a length of rubber-covered cable.

All electrical parts together with the drive and steering brake are rendered dust-proof as far as possible.

The portable electric hoist of this variety is chiefly intended for transportation in a vertical sense, since horizontal conveyance is limited to manual attention, and recent improvements chiefly relate to the use of increased power from the plugged-in connection, whereby a correspondingly greater weight may be elevated.

On the other hand, with earlier models of tiering trucks, the lifting range was restricted, as mobility was affected by the weight of all framework necessary where an increased height was demanded. In the modern truck, reinforced framework is utilised, while an independent electrically-operated brake is provided, so that in the event of a current failure from the mains, the load will be automatically prevented from dropping. In order to implement the desire for a light, but yet strong, outfit, use is made of double square-threaded screws for lifting purposes, and the introduction of alloy steels.

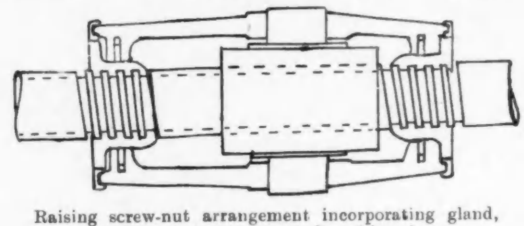
Although formerly the capacity for raising and transferring was limited to approximately 1 ton loads, considerable improvements have been made in this direction recently, but this is, of course, dependent upon the type of waggons and freight cars upon which the goods have to be placed, and too greatly increased a weight might be superfluous, as the doors and openings were not designed originally for the passage of more than a certain fixed amount. For this reason the 1-ton truck generally suffices.

Nature of the Mechanism and Platform Designs Used.

One of the basic features of the modern tiering equipment is the ease with which it may be dismantled, and re-assembled, which has been contrived with the object of directly facilitating shipment. The motor housing, screws, machine, cable, and framework are all purposely designed so that they may be immediately detached for re-assembly elsewhere. In order to forestall any damage to motor or drive from overload, such as some obstruction might cause, a slip-coupling is placed between the screw and the gears, which latter run in an oil bath.

The raising screw-nut in the cast-steel housing is privotally held, while the housing is pivoted to the frame, forming a universal joint as a whole, which embraces besides the nut and lifting screw, a gland, grease container, and wiper for continuously applying this grease, whereby sound lubrication is ensured. In this manner, the possibility of the screw binding in the nut is excluded. The glands, which are of the floating order, retain the grease in the container, or reservoir, through which the spindle passes. This system has, however, been competed with by the introduction of oil-less bearings, and at the moment rival claims have been made for both methods. In the zero position, the controller shaft is horizontal, while it is turned by means of a hand crank. Besides the up and down motion of the lifting platform being engaged by the turning of this crank, limit switches are furnished for both top and bottom positions, which may be adjusted to suit the nature of the elevating work on hand.

One of the features of modern truck of the kind is the construction of the platform itself. This may be represented by steel grids where it is known that hard material such as castings have to be dealt with, which would impair wooden platforms. Where boxes, drums, and other containers are handled, closely spaced rollers are substituted, which permits of these goods being conveniently rolled off without effort on the part of the attendant. Fittings and attachments are also used so that boxes may be connected, and furthermore, where the goods are of a light disposition, more than one box can be stacked one above the other and elevated simultaneously. This means that the lifting weight capacity of the outfit is fully utilised, instead of the more traditional system of limiting elevation to bulk, or volume, and in this way the maximum used is made of the power provided. Where bricks, refractories, and other hard-surfaced material have to be transported, care is taken to see that a separate protecting cover is placed on the platform to prevent it from being scratched and unduly worn. Where goods which already have a reliable foundation have to be handled, the ordinary platform is dispensed with, and in its place rigid arms are substituted. This relates to motors, engines, heavy oil circuit breakers, transformers and machines generally. A further device is used which takes the form of a U-shaped member, so that where fine and delicate mechanism, and instruments have to be elevated, the feet will be free from any danger of injury.



Raising screw-nut arrangement incorporating gland, grease container, wiper and steel housing.

It should be understood that these different devices are one and all fitted to the same tiering truck, to represent the best platform to suit the work on hand, and may be replaced in a matter of minutes, while the same mechanism is used throughout. Where a mixed cargo has to be unloaded, or re-loaded, the almost conventional time wastage, and allocation of definite storage spaces for different goods is thus largely obviated, as the handling can proceed literally unrestricted, with the minimum of labour, a feature which is sadly lacking at many warehouses and clearing centres at the present time.

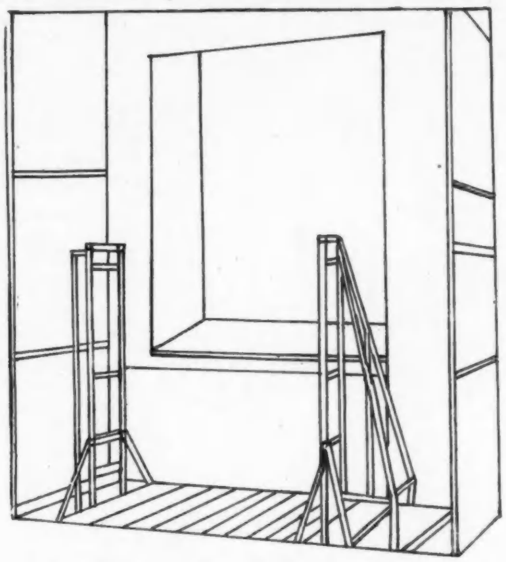
Constructional Features and Use of Floor Hatchways.

As regards the main features of the construction, the lifting screws are connected by an underslung horizontal shaft equipped with bevel gearing, while care is taken in the setting of the limit switches to see that the platform stops absolutely flush with any desired point. The framework is purposely made of the folding variety so that the truck may be run through doors and under obstructions, while also being enabled to convey goods through

Developments in Modern Tiering Trucks—continued

hatches. The frames, which permit of appreciable heights being reached for lighter loads, are sometimes made of the telescoping order.

Where the terrain to be traversed is liable to be soft, muddy, or uneven, steering of the truck is done by means of the front axle, but otherwise the usual two front wheels are employed for steering, with two fixed wheels at the rear. An important point is the means of turning the truck exactly on the right spot, instead of



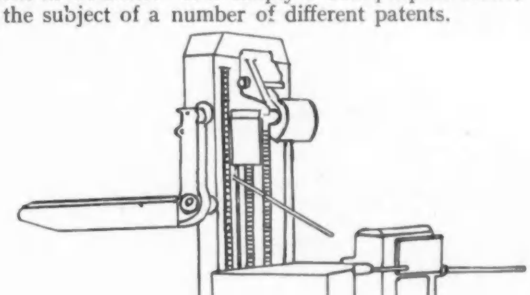
The light tiering truck is run up under different apertures or hatchways in the floor, thus taking the place of a set of hoists or elevators.

having to manœuvre where the space is very limited between aisles and rows of stacked goods, and for this purpose special patented wheels have been evolved, whereby the whole truck may be directly revolved like a turntable on two wheels. This latter arrangement is complemented by either screw stays or hinged stays, which, instead of being slowly screwed into position, are instantly put into operation by means of a lever device.

The double square-threaded screws already mentioned ensure a prolonged span of useful service for the lifting element, but a cable hoist, either alone, or in conjunction with these screws, is necessary for greater heights. When heights more than 3-ft. have to be served, a self-governing brake is sometimes preferred for automatic operation, while the double-jaw type of brake which is designed so as to be accessible at any time, is very popular. As regards current consumption, 0.3 to 0.1 kw. are required per foot-ton, while with the power-driven cable hoist, a maximum of 8.5-ft. is available. Although the battery truck has enjoyed great popularity, it means that much space has to be devoted to the bottom part of the truck unless special provisions are made at either end, and it is desirable that goods shall be removed from as close to the ground or floor level as possible. It was this feature which did much to revive the hand-moved truck where the work chiefly related to more or less direct hoisting, but different forms of running gear are also used. Where the plug connection is used for transmitting the power, the advantages of only using a limited personnel will be appreciated, as troubles with disconnections are largely obviated. One of the most valuable uses of the foregoing equipment at the present time is where warehouses and stores are dependent upon only one or two lifts, or elevators, which in the traditional manner are almost invariably located at one section of the building. It will be recalled at the time when air-raids were more prevalent, once any injury was sustained by the lifting equipment, the warehouse or store was placed in an unenviable position, and a tremendous amount of labour was often necessary to get the goods cleared from upper floors. The same cannot be said where the modern tiering truck is used, since all that is necessary is a hatchway in the floor, not at one point only, but at different convenient points. This means that even in peace times a considerable saving in labour is established, since goods may be elevated at different selected locations throughout the building. Provided with these floor apertures, a form of independence is gained which would not otherwise be possible, since the truck can be run up from one position to another as required. Not only this, but when it is desired to further raise goods to another floor, the truck can be again used, taking advantage of the hatchways in the floors. Where this is carried out on an elaborate scale, the controller shaft is frequently purposely extended into the building interior through the wall, so that it may be actuated by means of a flat-link chain and crank. Electrically-driven tiering trucks appear to be more popular on the Continent and in the U.S.A. than here, perhaps partly due to the good railway conditions which prevail in this country, but the subject should not be misconstrued as being competitive to the railway and hoist, since it is entirely for the purpose of loading waggons, lorries, and re-loading into warehouses as an intermediate form of handling.

Summary

As there are different types of models operated by screw drive, cable hoist, and a combination of these two, it is necessary to discriminate between them so that a true criterion is obtained of the extent of their working performance, and further as the total height can be increased by the addition of upper folding or telescoping sections. Thus one of the earlier trucks operated alone by power-driven raising screw was limited to a lift of 5-ft. with a maximum load capacity of $\frac{1}{2}$ ton. On the other hand, with the power-driven cable hoist, the same load could be lifted 8.5-ft. A smaller stoutly-built screw-driven truck, i.e., the box tiering truck, raised $\frac{3}{4}$ ton loads to 3-ft. The heavier truck specially adapted for dockyard use lifts 3 ton loads but is again limited to about 3-ft. heights, and this model uses a combination of power-driven screw and hoisting arrangement. Most of the trucks used for raising goods through hatchways use a combination of power-driven screw drive and cable hoist, and with the addition of the folding or telescoping upper section, the necessary support is thus forthcoming. Thus 1-ton loads can be raised to upwards of 12-ft., depending on the demand which is made. The steering brake referred to is a vital unit in most tiering trucks, as by the use of this medium the goods are not merely accurately elevated, but the dual lateral and elevating movements can be instantly terminated when the platform has been steered to the exact position, hence the reason for having it made dust-proof, so that it functions with precision at all times. It is simply a dual-purpose brake, but has been the subject of a number of different patents.



A heavy type of tiering truck specially adapted for dockyard work for elevating 3 ton loads.

Although apparently not well known in this country, the use of tiering trucks for passing goods through hatchways has been in regular service abroad for more than eight years, while arrangements for the interchange of platform fittings to accommodate different forms of handling dates back to several years before the present war.

Movable Bridges across Port Waterways

Development of the Chicago Type Bascule Bridge

By DONALD N. BECKER,[1] M.Am.Soc.C.E.

(Continued from page 118)

The Improvement Period

Between 1908 and 1911 several bridges were designed but it was not until a bond issue was passed in the fall of 1911 that funds were made available for their construction. This gave considerable time to develop new ideas and as a result there was a distinct change with the introduction of this new group of

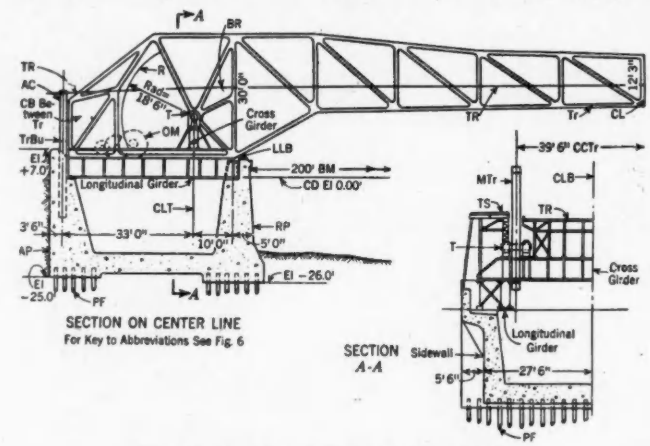


Fig. 10. East 92nd Street Bridge (1913).

bridges. During this period the city became increasingly conscious of the appearance of its structures and, as a result, the bridges have been given considerable study to enhance their appearance. In 1909 plans were drawn for a new bridge at West Lake Street to provide for the Lake Street Elevated Railway in addition to street traffic. A vertical lift bridge was designed but public opinion was so against its appearance that the plan was abandoned. Later in 1913 a double-deck bascule bridge was developed which will be discussed subsequently.

With this group the method of operating the bridge was changed. In 1908 Alexander von Babo, then Engineer of Bridge Design, invented the internal rack for which he filed an application for a patent on June 26, 1908, and which was issued on August 29, 1911. This patent provided for a rack in the plane of the trusses on the trunnion side of the counterweight box with the truss members arranged so that the bridge could rotate the approximately 80° required without any of the truss members fouling the pinion shaft of the gear train which drives the bridge. The radius of this rack is necessarily considerably less than that of the external pin rack used in the older bridges; but the science of machinery design and manufacture had advanced sufficiently to take care of the larger rack stresses involved.

In this same patent another feature was incorporated, called the cross girder, which consisted of a member being inserted through the truss to carry the inside trunnion journals. This girder was supported in turn upon girders parallel to the trusses, spanning from the front to back piers. In later years, this feature led to a suit for infringement by a competitor who claimed this same feature was incorporated in a patent granted to him earlier than Mr. von Babo's patent. This claim of both patentees was doubtless void as a feature similar to it was incorporated in a bascule bridge over the Tiber River built near Rome, Italy.[3] This cross-girder feature is only practical with two-truss bridges, as it would be impracticable to carry the heavy reactions of a truss on a girder except near the ends. The fixed part-floor system consists of stringers, supported upon this girder, passing over the counterweight box to supports over the anchor pier, instead of being framed between floor beams carried by the longitudinal supports for the inner trunnions formerly used.

Another change was made in the counterweight by forming the box large enough so that the necessary weight could be obtained with stone concrete, or, with only slight amounts of heavier aggregates to produce the weight required to adjust the centre of gravity to its proper location to balance the remainder of the bridge.

The truss outlines were made more graceful by the use of trusses of the pony type. They were only deep enough at the rear ends to provide an economical cross section for the truss members, and then they dipped gracefully toward the centre of the channel. The bottom chords were also given as much arching as the required underclearances prescribed by the U. S. War Department would permit. At this time the Government specified a 16.5-ft. clearance above Chicago Datum (normal water level) for 85% of the clear channel from which point the lower chords could be sloped downward.

A machinery girder was placed outside of, and parallel to, the longitudinal girder supporting the cross girder, at a distance of 6.5-ft., which girder together with the longitudinal girder, supported the machinery gear train. The gear train, in turn, was

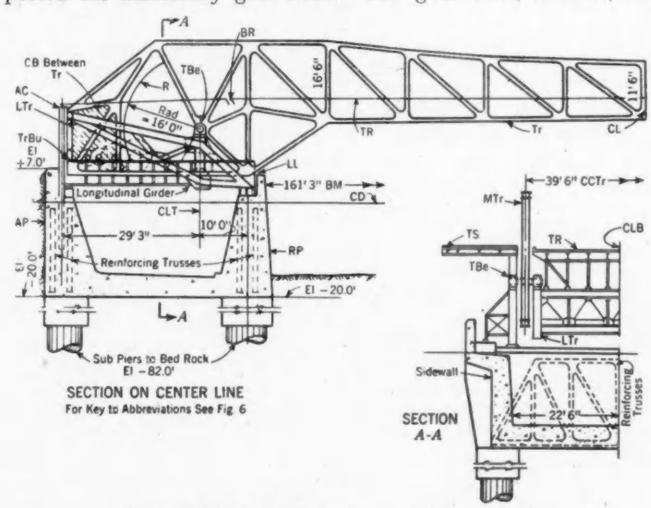


Fig. 11. West Chicago Avenue Bridge (1914).

mounted on a cast steel pedestal base. These girders also transmit the couple of the wind and operating moments to the masonry at the front and rear piers. Fig. 10 shows the East 92nd Street bridge.

With this group of bridges another new feature appeared in the substructure. At West Washington Street, completed in

*Reproduced from the Journal of the American Society of Civil Engineers, February 1943

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[3] "Industries," London, England, Vol. 14, 1893, p. 316.

Movable Bridges across Port Waterways—continued

1913, it had not been feasible to use piles to support the tail-pit boxes, due to the presence of the street railway tunnel under the river. Rectangular piers were sunk from the bottom of the piers to a point well below the tunnel where they rested on a hard clay stratum at El.—57.0 (Chicago Datum), capable of carrying a greater unit load than at higher levels. At the West Chicago Avenue bridge (completed in 1914, see Fig. 11), cylindrical piers were sunk to El.—82.0, where they were founded on hard clay.

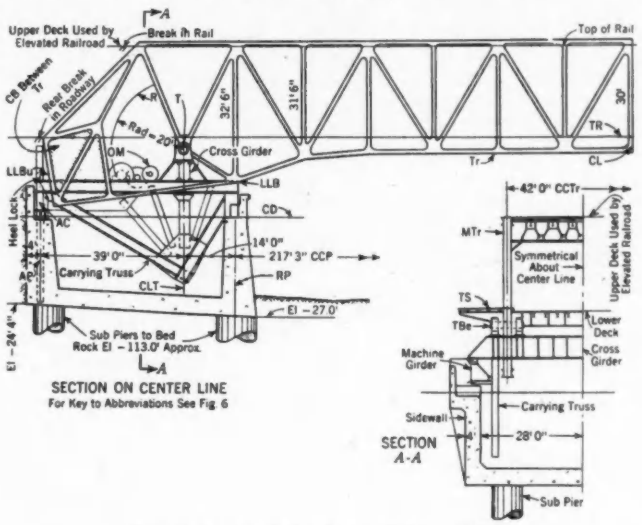


Fig. 12. West Lake Street Bridge (1914).

The spacing was sufficient to permit a future double-track subway tube to pass between them. Reinforcing trusses then had to be placed in the front and rear walls of the tail pit to carry the weight.

Following the bond issue of 1911, six bridges were placed under contract in rapid succession—five of the new double-leaf bascule type and one, a single-leaf bascule at West 35th Street, which was a duplicate of the Archer Avenue and Kinzie Street bridges previously described.

Of the five bascules, two—the Washington Street and Chicago Avenue bridges—had enclosures of improved appearance. In the case of the Washington Street bridge, the house was covered with sheet copper, and the Chicago Avenue bridge houses and enclosures were made of concrete, suitably ornamented. In the case of the bridges following these, extensive architectural treatment was applied to the houses and enclosures, first in concrete and later in stone or other durable materials.

In 1913 plans were prepared for a double-deck, double-leaf bascule bridge at West Lake Street (Fig. 12) to carry the elevated railway in addition to the street. Except for the necessary through-truss outline, this bridge had most of the features of the five previous single-deck bridges, such as the cross girder, internal rack, a longitudinal support for the cross girder (a triangular truss instead of a girder), machinery girder, unit machinery frame, and counterweight box with relatively light materials. Lead slag was used instead of stone to produce a concrete weighing 165-lb. per cu. ft. About the only unusual feature in this case was that everything was heavier, as witnessed by the fact that the trunnion load was about double that at the East 92nd Street bridge, the heaviest to that time. With these very heavy loads it was decided to rest the tail pits on cylinder piers carried to solid rock at El.—113.0 and with a clearance of 36-ft. to provide for a double-track subway at some future date. Chicago's subway has since utilized this space for a single bore of the Dearborn Street subway system.

With single-deck bridges it had always been practical to have the break in floor of the deck on the river side of the trunnion so that the raised leaf provided a barrier in the street. With a double-deck bridge, this was not possible so that a rear break in the floor was necessary, which does not provide a natural barrier in the street. Accordingly, it was necessary to provide some kind of a barrier at each end of the bridge. These were not put in at once but were installed at a later date. First, there was a semi-rigid type consisting of a timber pole that could be lowered into place and which would slide up an inclined grade if struck. Later a yielding barrier of the net type was developed, which plays out against friction drums when struck.

In many of the earlier bridges street traffic was accommodated during construction with a temporary bridge, usually of the so-called pontoon type. A truss span was supported at each end upon pile supports, and a scow placed beneath and near one end. By pumping water out of the hull, the truss at this end could be raised and the span could be rotated about a pin at the other end to clear the channel for navigation. At Lake Street, however, the presence of the elevated railway made this impracticable. After attempting to detour via other streets it was decided to maintain traffic by leaving the old swing bridge in place, and to support the approaches upon shoring. The length of the movable span of the new bridge was designed so that it could be erected in the vertical position clear of the ends of the swing bridge, and, as the bridge was erected, sufficient floor system was omitted to allow the elevated trains to pass through. When the leaf was ready to lower, traffic on the elevated railway was interrupted, the old swing bridge was turned on to the centre pier, and the centre section was cut out. The new bridge leaves were lowered after the omitted section of floor had been placed, the decking for the elevated railway was placed, and traffic was then allowed to pass over the new bridge with only a few days of interruption. No attempt was made to maintain traffic on the lower or street level.

Due to the fact that the bridge was balanced about the trunnion for dead load and had a rear break in the roadway, it was possible for live load to pass on to the rear ends only, which might place live load on the machinery brakes. Accordingly, heel locks were installed to take whatever live-load reaction might come on to them. These consist of toggle levers between the rear pier of the tail pit and a shoe on the rear of the counterweight box that were forced in place by machinery.

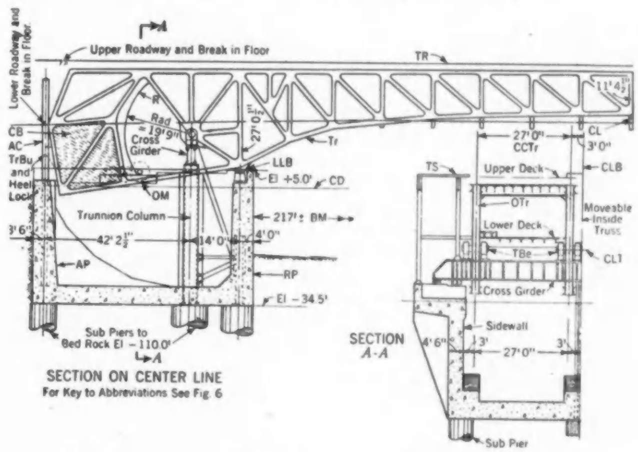


Fig. 13. North Michigan Avenue Bridge (1920).

In 1922 a similar bridge was completed at North Wells Street to accommodate the North-Western Elevated Railway. In this bridge the cross girder was supported directly upon a column embedded in the side-wall of the tailpit, with a sub-pier under the tail pit carrying the load down to rock at El.—117.0. This obviated the necessity of providing a heavy structural truss to distribute the heavy load to front and rear walls, the loading being 25% greater than at the Lake Street bridge.

Short girders framed into these trunnion columns spanning to the rear wall to carry the machinery gear train. These were not so heavy as formerly due to the omission of the bridge weight and

Movable Bridges over Port Waterways—continued

the shortened span. With this bridge the machinery stresses induced by a pressure of 20-lb. per sq. ft. on the upraised leaf were considered rather beyond practical bounds, so it was decided to scale it down to 16-lb. per sq. in. for the gear train, but to attach a brake directly to the tail end of the bridge trusses. This brake was to be of the pneumatic type and to consist of shoes working on a curved rail set in the masonry. After further consideration it was thought not to be very practicable, because of variable operating characteristics from moisture conditions; hence the regular machinery was left to handle extreme conditions. There has been some distress in the gear train, which has been corrected by replacing parts with higher strength steels than those originally used. Traffic maintenance during the erection of the trusses was similar to that at Lake Street, but with the added feature that the lower-deck traffic was maintained as well as the elevated traffic. The change over from the old swing bridge to the new bridge was made in 72-hrs. for elevated traffic, but the lower-level traffic was interrupted for month.

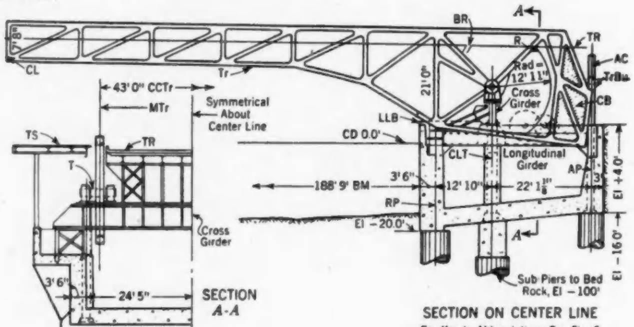


Fig. 14. West Madison Street Bridge (1922).

In 1920 the Michigan Avenue bridge was completed (see Fig. 13). This was the most unusual bridge built up to that time. As Michigan Avenue bridge was to be the link between the boulevard system of the north and south sides of the city, it was considered that a four-lane structure would not be sufficient. Furthermore, to separate commercial traffic from boulevard traffic, it was necessary to have two levels—the upper for boulevard traffic and the lower for commercial traffic. Accordingly, it was deemed necesssary to have an upper level with six lanes and a lower level with four lanes. It was decided to use four trusses spaced 27-ft., 6-ft. and 27-ft. with separated roadways on both levels for each direction of traffic. In effect, there were two bridges, side by side, connected with diaphragms, that could be cut out to permit one half to be operated while the other was put up in the air for repairs. (This contingency has not been used in 20 years, mainly because necessary repairs have been on the deck which had to be left down to work upon.) The two bridges were supported upon separate cross girders supported near the centre line of the bridge on columns to the floor of the tail pits and on trunnion columns in the side-walls. Yielding barriers were provided to protect traffic at both ends on both levels.

Machinery for this bridge consisted of two gear trains per leaf, one at each outside truss. Due to the importance of this bridge it was considered desirable to have an extra pair of motors for stand-by use if the two regular motors should fail; all four motors were grouped in a unit at the rear of the bridge with a clutch to select the pair to be used at any time.

In 1922 another novel type of bridge was completed at West Madison Street (see Fig. 14). At this location there was a clear span of 188.75-ft. and although the street grade on the west side of the river was reasonably high, it was not high enough to permit a deck type of bridge and yet leave a sufficient depth for the trusses. Accordingly, a new idea was developed, called the "railing-height truss," which means that the top of the top chord is at about the same elevation as the top of the sidewalk hand-rail, about 4-ft. above the walk. This gives the appearance of a deck structure from adjacent streets, as the top chord cannot be seen and, by the use of wide sidewalks, the trusses do not obstruct the walkways. Incidental benefits are that vehicles out of control on the roadway cannot get on to the sidewalk to crash into the river or injure pedestrians, and pedestrians are effectively barred from "jaywalking." By the use of nickel steel for main truss members, the sections were kept within reasonable bounds. Supports for the bridge were furnished by cross girders and trunnion columns as previously described for Wells Street.

Between 1911 and the end of 1923, thirteen city-type bascule bridges were built, three double-deck double-leaf bridges, nine single-deck double-leaf bridges, and one single-deck single-leaf bridge. The Sanitary District also built one single-deck double-leaf bridge on the South Branch at West Jackson Street. The total, to this time, was twenty-four city-type bridges.

(To be continued)

Correspondence

To the Editor of "The Dock and Harbour Authority."

Hydraulic versus Electric Quay Cranes.

Dear Sir,—

Referring to Mr. Dalziel's article dealing with dock appliances in the last issue of *The Dock and Harbour Authority*, and in view of the comments you make in your Editorial Comments, I do feel that in order to put the comparison between Hydraulic and Electric Cranes on an equitable basis, the following results obtained by operation of both types of crane over many years, should be given consideration.

The maintenance costs for hydraulic cranes are approximately one-third, as compared with electric cranes. Further, the hydraulic crane has such characteristics that the overload capacity is, with usual design, automatically about 25% without the use of automatic relays, also due to the low speed of the ram the damage caused by hooks or loads fouling hatch coamings is very much less in the case of the hydraulic crane owing to the kinetic energy of the moving machinery being less.

Regarding the speed of hydraulic cranes with reference to electric cranes, there is no difficulty whatsoever in obtaining the same speed with a hydraulic crane as with an electric crane, and in connection with this I may say my Company have hydraulic cranes having a full load hook speed of 600-ft. per min. Further, the acceleration from rest to full speed in the case of hydraulic cranes may be, if necessary, higher than in the case of electric cranes.

The number of breakdowns per annum in the case of hydraulic cranes is infinitely less. The attendance as an insurance against stoppages is also much less than in the case of electric cranes, and in the majority of cases, provided the cranes are maintained efficiently, attendance during the working period may be dispensed with.

Under these circumstances, in my opinion where a hydraulic service is available or where the number of cranes is sufficiently large to warrant the provision of a hydraulic service, consideration should be given to hydraulic operation, particularly if the hydraulic crane system can be kept within a prescribed area, relatively small electro-hydraulic automatic stations being provided to give the hydraulic service.

I agree that power costs for hydraulic working are higher than direct electric operation, but in view of the proportion of power costs to maintenance costs, and the relative maintenance cost for hydraulic cranes as against electric cranes, the cost of the provision of power becomes a secondary consideration.

Yours faithfully,

13th September, 1943. C. H. NICHOLSON,

Docks Machinery Engineer.

Chief Mechanical Engineer's Department,
London and North Eastern Railway, Hull.

The Central Advisory Water Committee

Proposed River Boards

The third Report* of the Central Advisory Water Committee issued in August, is of importance to Dock and Harbour Authorities and Canal Undertakings by reason of its proposals for the establishment of River Boards to take over certain functions relating to Navigation which are at present in the hands of existing bodies for river control.

The following are excerpts from the Report in which reference is made to the matters involved:

Inland Navigation

Many of the navigable non-tidal lengths of rivers in England and Wales are controlled by Navigation Authorities who have usually been set up by local Acts, although in some cases the powers of the authority are derived from some ancient Charter or are based merely upon proprietary rights. The Authorities are of great variety—Commissions or Boards, comprising representatives of Local Authorities, canal interests and barge owners, or other persons paying tolls; incorporated companies trading for profit; Railway Companies; Municipal Corporations; Land Drainage Authorities; and private persons. It is not uncommon to find two or more Navigation Authorities controlling different lengths of the same river. The Authorities have general powers to control navigation and levy tolls, and to maintain and improve the rivers for navigation purposes. Their income is derived mainly from tolls on craft using the river, and from water and other rents.

Prior to the passing of the Act of 1930, a number of Drainage Authorities possessed navigation powers which have in some cases subsequently passed to the Catchment Boards concerned. That Act also enables Drainage Boards, with a view to improving the drainage of their districts, to enter into agreements, with the consent of the Ministers of Agriculture and Fisheries and War Transport, for the transfer to such Boards of the whole or part of undertakings of Navigation Authorities, or for the alteration or improvement by the Boards of any works of the Authorities. The Minister of War Transport may also authorise a Drainage Board to levy navigation tolls on navigable waters which are not under the control of a Navigation Authority where he is satisfied that the cost of maintenance or works in connection with those waters has been or will be increased as a result of the use of those waters for purposes of navigation. If the powers of a Navigation Authority are not properly exercised, the Minister of Agriculture and Fisheries, after consultation with the Minister of War Transport, may, by Order, with a view to securing the better drainage of any land, revoke or vary the provisions of any local Act from which they are derived. The Order becomes provisional if opposed.

Canals

We are informed that excluding the Manchester Ship Canal, there are over 900 miles of canals owned by Railway Companies, and over 1,500 miles of canals owned by 31 canal undertakings, still in active use. The average tonnage of goods and materials conveyed over these canals in the years 1935-37 was nearly 18¼ million tons per annum.

Canal undertakers were originally incorporated by local Acts. In some cases the undertakings have been acquired by Railway Companies and in a few cases by Conservancy or Local Authorities. The undertakers' powers are specified in the local Acts, the Railway and Canal Regulation Act, 1854, and the Railway and Canal Traffic Act, 1888. The Acts sometimes include the power to impound one or more rivers in order to provide reservoirs to feed the canals, or to take water from rivers, streams and wells within a specified distance of the canals for that purpose, but do not always provide for compensation water. In many instances the waterways belonging to or used by the undertakers traverse and draw water from more than one watershed area.

A large part of the traffic over canals and inland navigations is through traffic passing over waterways owned or controlled by different undertakers. Several of the canal and inland navigation undertakings include commercial facilities such as docks, warehouses and similar works and buildings which are not part of the actual navigation.

Tidal Navigation and Dock and Harbour Authorities

There are upwards of 100 local Navigation Authorities exercising jurisdiction in tidal river waters. In most cases their powers are derived, not from a general Act of Parliament, but from a local Act, or from a Provisional Order subsequently confirmed by an Act. In some cases, however, the powers of the Authority are based upon an ancient Charter or merely upon proprietary rights. Some of the Authorities have conservancy powers only, and others own piers, quays, wharves, docks, etc. The Authorities are usually *ad hoc* bodies of commissioners, conservators, trustees, etc., set up and constituted on lines prescribed in the local Acts, the most usual basis being partly election and partly nomination. Other Navigation Authorities are companies, including Railway Companies, or Local Authorities whose local Acts add navigation powers and duties to their general Act functions.

The powers of Navigation Authorities differ widely, but as a rule they include a power to levy dues on vessels using the waters over which the Authorities exercise jurisdiction, and the duty of preserving and improving the facilities for navigation in those waters. We are informed that the Board of Trade,*as the Central Department which by constitutional usage is charged with the duty of safeguarding the public right of navigation in tidal waters generally, always consults local Navigation Authorities on any matters affecting their interests and does not interfere with the exercise of their local jurisdiction except in cases where the interests of the public right of navigation, or the Crown's proprietary rights (where they exist) appear to be involved.

Ports

Out of 171 ports in England and Wales, 7 belong to the Government, 40 are owned by railway companies, 26 are privately owned, 43 are municipally owned, and 55 are owned or controlled by Commissions or Boards of a representative character, such as the Port of London Authority and the Mersey Docks and Harbour Board, which were set up by local Acts to manage docks, harbours and tidal waters in the interests of trade. These Commissions or Boards are in the nature of public trusts. They do not work for profit but carry on the undertakings solely for the benefit of trade, surplus income being utilised for reducing the rates charged on shipping and goods or for improvements for the benefit of trade.

Review of Evidence

The Canal Association objected to any general transference of powers and functions relating to navigation to new River Boards on the grounds that difficulties would arise from the combination of the trading and business functions of canal undertakers—who compete to a large extent with other forms of transport—with the purely administrative functions of other Authorities, and that it would be impracticable to divorce transport and trading activities from the navigation functions exercised by the undertakers. They also apprehended that navigation systems with artificial waterways might have to be placed under the control of two or more Boards, unless the existing undertakings were regrouped, which would give rise to serious problems in regard to the redistribution of capital and reallocation of capital expenditure. Other drawbacks would be the difficulties of dealing with through traffic and the transfer of property, including docks and warehouses, which are not part of the actual navigation.

The views of the Dock and Harbour Authorities' Association in regard to navigation in tidal waters were similar to those expressed by the Canal Association. The Association were opposed to any general interference with the jurisdiction of the existing responsible Authorities over tidal waters, or the separation of the responsibility for the maintenance of channels from other functions adminstered by Navigation Authorities.

*Published by H.M. Stationery Office. Price 1s. 3d. net.

*Now Ministry of War Transport.

The Central Advisory Water Committee—*continued*

Separate evidence on this question was given by two Inland Navigation Authorities, the Severn Commissioners and the Weaver Navigation Trustees. The former body, consisting of 30 Commissioners appointed by the Commissioners of the Peace for Gloucestershire and Worcestershire, Local Authorities and landowners is exclusively responsible for the navigation of the River Severn—the area of jurisdiction extending from a point above Stourport to a point near Gloucester—and claim to be consulted on all questions arising outside their area which may affect that navigation. The Commissioners, while opposed to the transfer of any of their functions to a new Board with comprehensive functions, would, it is understood, be prepared to consider taking over duties other than navigation, and were of opinion that it would be of advantage if co-ordination of the river interests in the River Severn were effected in this way.

The Weaver Navigation Trustees, who are responsible for the navigation of the river, are nominated by the Cheshire County Council, District Councils and toll-payers, the majority of the Trustees being appointed by the County Council. The Trustees were of opinion that since navigation was the preponderating interest of the river, their powers should not be transferred to a new Board. They would be willing, however, if their constitution were not materially altered, to undertake the administration of fisheries, land drainage and the prevention of pollution, and were definitely of the opinion that some of these functions, e.g., land drainage, would thus be carried out more efficiently than with the present divided responsibility, that adequate representation could be afforded to interests other than navigation, and that it would be feasible by divorcing the income obtained from tolls (on which the navigation relies at present) from the revenue obtained in other ways, to ensure that the other interests were not prejudiced.

Conclusions and Recommendations

It is recommended that if new River Boards are formed for areas where Catchment Boards are now responsible for navigation, the powers and duties of the latter should be assumed by the new Board. Also, that in the case of the smaller non-industrialised rivers the functions of navigation might well be transferred to the new Boards.

A general transfer of the functions exercised by inland river Navigation or Dock and Harbour Authorities to the River Boards, would cause serious difficulties. Such a transfer would necessitate a corresponding transfer of properties and liabilities, which would entail the payment of compensation, and complicated financial adjustments where river Navigation Authorities were concerned with more than one watershed area. Apart from these considerations, it may not always be wise to interfere with *ad hoc* local bodies and commercial undertakings which have gained considerable experience of the working of a specialised industry, and to burden the new Boards with the additional responsiblities of trading undertakings.

We have considered whether functions now exercised by River Navigation and Dock and Harbour Authorities, such as the dredging of channels, which sometimes overlap or clash with those of other river Authorities, should be divorced from their functions of a commercial nature and whether the new Boards should be made exclusively responsible for the former.

As far as tidal waters are concerned, we are satisfied that, with the exception of prevention of pollution, to which reference is made later, there will not necessarily be interference with the work of the new Boards if navigation and other similar Authorities retain their present responsibilities within their existing limits of jurisdiction, and if the powers and duties of Catchment Boards in relation to tidal waters, are transferred to the new Boards.

There are, however, very exceptional cases like the Humber, where we are informed that great damage is being caused by the action of the tidal river in eroding the foreshore and otherwise, and where the interests and responsibilities of the Conservancy and the several Catchment Boards are closely interwoven. In such a case it may well be that exceptional treatment will prove necessary.

The question of inland river navigation is more debatable, and we are not convinced that it would be impracticable to confer the exclusive responsibility for the maintenance of navigable channels, with the power of levying tolls to cover the cost, on the River Boards. It is very doubtful, however, whether in all cases the difficulties due to the division of responsiblity would be sufficiently serious to justify this course, or whether the advantages which would result would outweigh the disturbance that would be caused by a general curtailment of the powers of Navigation Authorities, and we recommend, therefore, that there should be no general transfer of functions relating to inland river navigation to the new Boards. These functions might, however, be added at once in suitable cases, or at a later stage if and when, in the case of each river considered separately, experience has indicated that this step would be practicable and advantageous.

It is considered, nevertheless, that there should be wider powers to facilitate co-operation between Land Drainage and Navigation Authorities, or the transfer of navigation undertakings to the new Boards in suitable cases. There is machinery already in the Act of 1930, but, as we have indicated, it applies only for the purpose of improving land drainage. We recommend that this restriction should be removed, and that the Act should be amended to allow River Boards and Navigation Authorities to enter into arrangements for the transfer of navigation undertakings to the Boards, and for the alteration or improvement of any works for which the latter are responsible, irrespective of whether or not those arrangements are required for the improvement of land drainage.

The transfer to the Board controlling a particular river of authority in relation to canals fed by water which would otherwise flow into the river might be considered, especially as a canal frequently carries water from a number of watersheds and finally discharges it into one into which it would not naturally flow. This authority, however, may need to be confined to those canals which are no longer functioning or which may cease to function in the future. Such canals and their towing paths are very frequently the type of watercourse and adjoining land which can be adapted very satisfactorily for amenity use by the public.

To sum up, we have come to the conclusion that no serious difficulties would arise if the new Boards were made solely responsible for the duties now carried out by Catchment and Fishery Boards and for the administration of the Rivers Pollution Prevention Acts, and were also given specific duty in relation to the conservation of water in their areas; and that the co-ordination of these functions under one Authority would, in the long run, be to the advantage both of the sectional interests mainly concerned and of the general community.

We also consider that there should be powers for the new Boards to apply to the Ministers of Health and Agriculture and Fisheries for an Order, which should only be made after consultation with the Ministry of War Transport or any other Department in which the powers of Central Navigation Authority are vested, for the transfer of Navigation, and Port and Harbour undertakings. The Order to be Provisional if opposed and not to have effect until it is confirmed by Parliament.

Obituary.

The death has been announced at St. Austell, Cornwall, of **Captain E. M. Sincock.** He was for fourteen years Harbour Master at Avonmouth, Port of Bristol. He first joined the staff of the Port of Bristol Authority as a relief dredging master. In 1915 he was appointed assistant dock master under Captain W. Robertson and succeeded to the Harbour Mastership in 1929.

The Re-opening of North Shields as a Herring Port.

North Shields has been re-opened as a herring fish port by the Ministry of Agriculture and Fisheries who have lifted an embargo which had existed since the outbreak of war. Local representations had been made that the adjacent harbour of Seahouses could not cope with the large catches of fish. In their appeal to the Ministry, the herring merchants pointed out the advantage in direct handling and the saving in road and rail transport.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this Journal should not be taken as an indication that they are necessarily available for export.

Fire Hazards at Ports and Docks

With Particular Reference to War-time Conditions

By J. A. JEROME.

Continuity of supplies, uninterrupted by fire, is an essential objective in our war offensive. The war has greatly increased the difficulties of those responsible for seeing that the proper precautions are observed for preventing loss through fire in ships and buildings associated with marine transport. Because of this, a broad examination of the problems should prove worth while.

The Phases of Transit

In great ports such as London, Liverpool or Glasgow, most goods pass through three distinct phases. Following an inward movement, the observer finds that firstly, the cargo stowed in the holds and 'tween decks of ocean-going vessels is unloaded alongside the quay or dock wall. The second phase takes in the cargo's brief repose in the great dock sheds or in the open.

Finally, changing its name to merchandise, it finds its way to the warehouses—usually owned by storage companies—or to the great marshalling yards—the property of the railway companies. With outward-bound traffic, the process is reversed. Moreover, one or two of the phases may be elimated, when for instance, there is direct transhipment to lighters or small coasters.

In each phase, the same basic laws of combustion remain, even though they are determined by different structural circumstances. Therefore, basically identical precautions, such as the strict control of smoking, must be enforced.

The technical requirements of cargo stowage in the hold of a ship vary in detail from warehouse storage, which is built of material less conducive to heat. Nevertheless, in relation to those causes of fire generally associated with human carelessness and lack of forethought, the precautions are similar.

Causes of Fires

The figures showing the causes of fire in various types of property in one large port, indicate that of 79 fires, 40 were attributed to origins where the human element entered.

Ten were due to lights dropped, 11 to blow lamps or cutting apparatus and 14 to sparks of various kinds. Of 26 fires in dock sheds, at least 8 were attributed to causes associated with carelessness and of 30 fires in warehouses and store yards, 14 were due to causes of this nature, including 5 resulting from children playing with fire and 1 through smoking.

Welding Risks

In ships, the blow lamp and the oxy-acetylene cutter are prolific causes of fire and the quick turn-round of ships in wartime conditions, with repairs going ahead simultaneously with loading, accentuates the incidence of such outbreaks. One dangerous habit in this connection is the lighting of blow lamps with twisted pieces of greasy tow and the hanging up of this lighted improvised taper for use should the lamp fail. Again it is possible to cite one recent case where sparks from a cutter ignited the oil floating on the surface of a dock.

Sparks from the funnels of passing vessels are inevitable, but they are unlikely to cause trouble on clean decks and superstructure coverings free from oily waste and unnecessary rope ends.

Careless Electrical Maintenance

In troopships and vessels fitted with refrigerating space, the electrical installations are exceedingly complicated and may involve miles of high grade electrical cables.

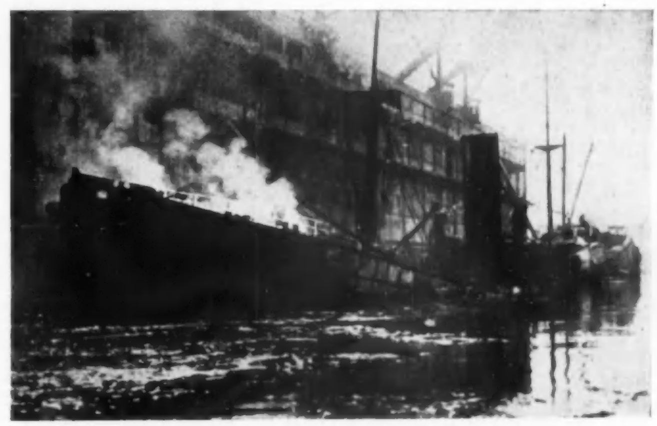
A busy electrician engaged on maintenance work and rushed for time, fails to insulate a job in the proper manner. Perhaps weeks or months later, the vessel has to pull out those extra few knots to avoid a submarine and there is additional vibration; the faulty insulation goes; a short circuit occurs and fire under the most dramatic circumstances breaks out—poor dividends for the saving of a few paltry minutes!

Self-Heating Cargo

Long voyages add to the hazards of self-heating cargo—that is cargo in which there is slow chemical or bacteriological action producing heat and, in certain circumstances, spontaneous ignition. A careless action many miles away from either ship or port, may add to this hazard.

A negro in the Southern States of America introduces an apparently harmless piece of vegetation into a cotton bale. Without incident, thousands of bales are transported in similar conditions but the one bale containing foreign matter fires spontaneously and ignites others. A joiner in Birmingham drops an unused match into a crate and instead of lighting his pipe, it sets fire to a valuable cargo in dock or mid-ocean.

A certain amount of heat due to friction may be unavoidable on a ship in a heavy sea, but the slightest negligence or carelessness on the part of a stevedore's labourer, if not discovered in time, may result in just that extra freedom of movement which produces frictional heat sufficient to cause a fire at sea.



Fire on ss. "Oklahoma." Ship carried a cargo of Peruvian cotton, sugar and nitrate of soda.

Chemical Reaction in Cargo

For a considerable time, it has been known that the stowage of certain types of cargo in contact with other types causes fire through a chemical reaction between the two substances. Where oxygen-producing chemicals, such as nitrates, are in the neighbourhood of carbons in the form, say, of sugar, a highly dangerous situation arises which is likely to result in a spontaneous outbreak of fire. In the same way, oxidising oils such as linseed, coming into contact with cotton or other textile materials are subject to a similar phenomenon. Until workers and employers grasp the dire consequences of these dangers, all the instructions in the world are of no avail in putting down fire. Unless a case of real necessity arises, authorities are well advised not to over-ride regulations which are based on the fruits of bitter experience.

Containers of phosphorous should be treated with great respect. Their damage due to indiscriminate and rough handling may also be sufficient to produce a fire without the presence of any other agency. The same applies to sodium, which, when in contact with water, liberates a considerable quantity of hydrogen.

Calcium carbide too, should be religiously kept away from water; the generation of acetylene gas and its combustibility is known to any person who has experience of welding, or who has used a carbide cycle lamp; its wide explosive range in air, from 2.5 to 80 per cent. by volume, demonstrates its great risks.

Bunker Fires

Bunker fires of spontaneous origin are a familar phenomenon both at sea and in port. Several of these fires occurred recently after English coal had been tipped on to foreign coal left over from the inward voyage. The practice has been strongly discouraged with good results, but it should be stressed that a very small residue of old bunker coal left over in an odd corner, may cause trouble.

Fire Hazards at Ports and Docks—continued

The Greatest Hazard of all

Among all the dangerous material afloat and in port, volatile spirits such as petrol—particularly high octane aviation spirit—take first place. Mixed with air in the proportion of one to six per cent., the vapour takes on a highly explosive character. Moreover, it produces its own "fuse" in the form of vapour and an ignition temperature of 495° F. is sufficient to detonate it. A trail of vapour may become extended for a quarter of a mile or more. Should contact be made with a spark, a naked flame or a smouldering cigarette at the end of the trail, a flash will rush back to the hold or tank in which the liquid is stored and the resulting explosion may be catastrophic.

Elaborate precautions are taken at tanker berths of great oil installations, refineries and at storage and distributive centres. Smoking is prohibited, cigarettes and matches are surrendered at the gates and flexible steel tubing used in discharging or taking on oil, is rope-covered to prevent friction sparks. Where necessary, tankers are earthed on berthing to discharge static electricity in the hull. But despite all these precautions, at least one recent disaster has been attributed to a friction spark and it is believed that one of the victims failed to follow the statutory regulations on the matter.

Owing to the demands of war, the carriage of large quantities of petrol in tins, ready for immediate distribution at disembarkation ports has been made necessary. It is impossible to overstress the need for the gentle handling and careful stowage of these containers. Here again, the warning should be sounded loud and clear: *NO SMOKING, NO NAKED LIGHTS* anywhere near the environs of even the smallest amount of packed spirit.

Sheds and Warehouses

The dock shed is usually a single-storey building of non-flammable construction. Occasionally, there is an upper floor, but even so, the fire risk is fortunately low. Goods remain in the dock-shed for comparatively short periods and, since there are people in constant attendence, the surreptitious smoker has little opportunity for indulging his dangerous habit.

The warehouse on the other hand, is usually a multi-storey building and is often of considerable age. Goods may remain in it for long periods during which time, an opportunity for heating in goods liable to fermentation and consequent self-heating, crops up. It is therefore a wise practice to keep close watch on such stocks and segregation of these commodities from those less liable to this kind of fire phenomenon is a wise procedure.

Arrangements for Accessibilty

The storage plan behind the deposit of stocks in warehouses should always take in the need for ready accessibility. If what virtually amounts to a job of demolition has to be undertaken amongst crates and bales etc., before a small outbreak can be reached,the blaze may rapidly get out of hand, develop into a fully-fledged fire and threaten the bulk supplies. Also, a situation may develop where a fire fighter has to scramble over the tops of stacks, and, to ensure freedom of access, goods should not as a general rule, be stacked within three feet of the ceiling.

This proviso has a special significance where sprinklers are installed, for goods rearing up to the sprinkler heads impede the dousing action, and defeat the basic principles behind sprinkler extinguishment.

Great vigilence must be exercised in seeing that matches and cigarettes are not taken into warehouses. A quiet smoke behind a bale of cotton is a pleasurable prospect for a hard-worked employee. But a chance cigarette end, or a piece of glowing ash tossed into a cotton bale or amongst hessian packing material may go on smouldering for hours, and fire may suddenly burst out when least expected and the stage is set for a major conflagration.

Check for Electrical Faults

It is often impracticable to-day to employ a qualified electrical maintenance man. Should electrical repairs be carried out by an inexperienced person, the work should be examined by a qualified person of full responsibility.

Close check upon all electrical circuits and equipment should be made at regular periods. There was one case of a warehouse fire where an insulated electric conductor in wood casing fretted. It was reduced to needle-point dimensions until an arc was formed which in turn, set fire to the insulation and casing. The contents of the premises caught fire and valuable stocks were lost.

Consequences of Carelessness

In peace-time, only trusted warehousemen and watchmen were permitted to enter such buildings at night, but now, the imminence of enemy action has made it necessary to augment their services by others whose conscientiousness may not be so highly marked. The curious instance has arisen of a fire originating through the carelessness of a fire guard, and the tightening up of discipline in this respect is to be applauded.

The ship, the dock shed and the warehouse—these are the risks in the great ports. Through them pass merchandise valued not only in millions of money but in terms of human life, survival —victory. One tiniest act of carelessness may result in the sinking of a ship, the dislocation of dock traffic, the interference of supplies on which a major military plan may depend for its success or failure.

Notices and regulations are useless without the goodwill and care of the army of workers engaged in dock work and indeed, of workers throughout the country.

Only when this has been achieved shall we defeat one of the most dreadful scourges which has ever challenged, wrecked and desolated the fruits of human effort.